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## Exploring Empirical Guidelines for Selecting Computer Assistive Technology for People with Disabilities

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Exploring Empirical Guidelines for Selecting Computer Assistive Technology for People with  
Disabilities

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Science

By

Jennifer Border  
B.S., Wright State University, 2008

2011  
Wright State University

WRIGHT STATE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DATE MARCH 7, 2011

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Jennifer Border ENTITLED Exploring Empirical Guidelines for Selecting Computer Assistive Technology for People with Disabilities BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science.

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## ABSTRACT

Border, Jennifer. M.S., Department of Psychology, Wright State University, 2011. Exploring Empirical Guidelines for Selecting Computer Assistive Technology for People with Disabilities.

Assistive technologies (AT) enable people with disabilities (PWD) who are unable to use traditional computer workstations to independently access computers. The selection process of AT is complex due to the numerous AT available and the specific needs of the user. This study examined the process to select new AT for a PWD with Arthrogryposis. In part 1, a series of two different typing sessions (typing test & journal response) were completed by three different AT (voice recognition (VRS), head tracker (HT), & brain computer interface (BCI)). In part 2 only journaling sessions using VRS & the user's traditional typing method (touch screen) were completed. Quantitative & qualitative data was analyzed for both parts. For the current PWD, a combination of HT and VRS AT was selected as AT choices. Her results provided a discovery of important AT features and implications for improving AT selection for the general population. Future research is needed to explore these implications.

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## **Introduction**

Staying up all night writing, editing, and rewriting class papers, proposals, thesis's, and publications is common for graduate students. Long, endless hours hovered over a small keyboard pecking at each key, is part of an unspoken, but universal agreement all graduate students, especially research-oriented ones agree to once they enter a program. These students know that extensive amounts of typing using a traditional QWERTY keyboard by hand have consequences by causing temporary pain and developing into repetitive motion injuries. Many people accept these consequences as minor compared to the reward of graduating and completing a thesis or dissertation. However, for others, pain and possible injuries are not acceptable and alternative typing methodologies are used. I, the author of this thesis, am one of these individuals who currently use alternative typing methods, due to a physical disability that makes using a traditional keyboard difficult and sometimes painful to use. I have used alternative typing methods with a variety of assistive technology to type since I was five years old. My alternative typing methods and workstation has evolved over time and has separated into five distinct workstations in my past to make it easier. My current workstation consists of me lying on my bed leaning on my shoulders using a stylus in my mouth on either a tablet pc with an on screen keyboard or traditional computer with keyboard to type. This setup has worked well for 10 years, but now has caused me to develop a repetitive motion injury in my shoulders. In order for the injury to heal, I must find a new typing methodology and workstation using different assistive technology. There are three goals to this thesis.

- The first goal is to find a new assistive technology for myself that alleviates my repetitive motion injury. In this search for a new AT for me to use, I specifically investigate AT

that enables me to complete extensive typing efficiently in a home-office environment.

Other potential uses of an AT are mentioned, but not examined thoroughly.

- The second goal is to examine quantitative and qualitative details of three AT's that represent different dimensions of possible adaptive typing solutions for myself specifically and in general for people with disabilities (PWD) with arm limitations. This examination enables me to learn what specific characteristics and dimensions I prefer that are key to my selection of a new assistive technology (AT). As I examine the specific features and dimensions of AT in this thesis, specifically the three AT used, I must take into consideration that the AT selected represent a small diverse sample of the total population of possible AT solutions. Additional ATs and dimensions are available and should be examined in future research. The three AT selected were head tracker, BCI, and voice recognition software. They were selected for their geographical accessibility to me on the university's campus.
- The third goal is to formulate and recommend future research for improving methods to select AT for the general population of PWD based on the implications found in my exploration and search for a new AT. My specific individual needs may be different from others within the PWD community, but the specific characteristics and dimensions that led me to choose a particular AT may be the same for other PWD.

### **Understanding the Goals**

In order to complete the three goals of this thesis, I used a framework from cognitive systems engineering that enables a better understanding of achieving success in dynamic human-computer interactive systems. This framework is explained by problem and solution spaces (Chalmers et al., 2002). The problem space consists of the work environment that contains all

the dimensions that influence and are related to the specific problem in the dynamic system (Chalmers et al., 2002). Specific areas of the work environment include the work domain, the personal and cognitive attributes of the human users that interact in the dynamic system, and their organization, policies, doctrine, tactics and procedures. The work domain is the purpose and structure of the system, independent of any particular operator, automated controller, event, task, goal, or interface (Vicente, 1999). To assist in evaluating the problem, researchers use the idea of solution space to evaluate potential solution options. The solution space is the artifact space where actual design, implementation, and evaluation of all possible solutions to the given problem and dimensions that correspond to the solution's success rate exist (Chalmers *et al.*, 2002). In this thesis, the first two goals are examined using a problem and solution space. The third goal explores possible key parts of the process necessary to reach the first two goals. This exploration of key parts will be used to setup the background information needed in future studies.

In this study, the problem is that I need to find a new AT workstation due to my repetitive motion injury. The problem space is a general framework for all PWD but I am applying it specifically to myself and characteristics of myself that influence the AT I select as a user with limited arm movement in this case study. The solution space is all the viable AT solutions that I can use on a computer given my limited arm movement and dimensions of the solutions that affect the overall interaction I have with the computer. In order to find a new AT for myself, I must thoroughly understand the dimensions within the problem space, the possible solutions and the different dimensions in the solution space, and analyze specific dimensions of both of the spaces. Although a full understanding of all of the dimensions in the problem space and the solution space was optimal, it was impossible to do completely. It is impossible to do because

all of the dimensions in both spaces revolve around current human capabilities. Humans and human made technologies naturally evolve and change over time at sporadic rates. Due to this ever-evolving unpredictable nature of human life, I could only provide dimensions in both spaces at the currently known capabilities and documentation of humans. In the problem space, I stated the dimensions within the space using my current knowledge of my life, and myself, but at any time a dimension can be modified, added, or deleted due to my personal adaptations to life. In the solution space, I list the main types of AT and the corresponding dimensions currently available. However, the solution space can always be modified due to inventions of new AT and the never-ending modifications and adaptations humans do using previously invented AT.

**User Selection.** I, the researcher am also the only participant in this self-study. A self-study is a type of case study where the researcher uses his or her experiences as a resource for their research that involves practical personal, professional, or program renewal (Feldman, 2002; Lassonde, Galman, and Kosnik, 2009). A general strength in using self-study designs is that it combines the scientific process of research with the practicality of the human experience (Korthagen, 1995). This combination promotes human effectiveness and provides a forward motion to actual human actions. In addition, self-studies can develop better understanding of a problem and can form a resulting solution in complex systems by learning the patterns in the relationships among the involved researcher who could also be a user and other agents in the system (Cilliers, 1998; Gell-Mann, 1994; Stacey, 1996; Wheatley, 1992). Weaknesses involved in using self-studies are the difficulty in establishing credibility and validity of the researcher's and the possibility of the findings in the sample size of an "n" of one not reflecting the opinion of the general population (LaBoskey, 2006; Yin, 1984).

For this particular study, a self-study is a beneficial methodology, even with the possible weaknesses due to its ability to facilitate an understanding of the relationship the user attempting to select an AT has with the different factors that influence the selection. Specifically, a self-study allows me to study the different connections that develop between components in the complex process of selecting AT for PWD from the unique perspective I have. There are four reasons why my perspective is unique and should be used in studying the selection of AT for PWD. First, I am an individual who has a disability and requires AT for every day necessities. I am the most knowledgeable about my own physical constraints, personal constraints, and desires as a PWD, my environment, and my goals. In addition as a PWD, I fully understand the challenges and rewards that are unique to living with a disability. Secondly, I am becoming a professional in the human factors field. As a new professional, I am being given the tools to develop processes centered on the end user for making decision selections in complex environments. Third, researchers need to observe PWD who currently are in the process of selecting AT, and I am a PWD who must make a new AT selection due to my repetitive motion injury caused by my current AT set up. A more in depth explanation of my injury will be discussed in the next heading. Observations help researchers to learn specific features and dimensions of AT that are important to PWD that then can be used to formulate a more efficient AT selection process for PWD. Fourth, the combination of being an end-user in the AT selection process and as a professional who understands the process of such approaches enables me to examine this problem from a holistic perspective.

### **Problem Space Dimensions**

In the problem space, there are five known different dimensions. There could be additional dimensions of the problem space due to the unpredictable nature of working with



humans and the way we live our lives. However, right now I am focusing on a combination of five dimensions that are in current AT selection methods. The first AT selection method that I examine dimensions is the Human Activity Assistive Technology (HAAT) model. The HAAT model takes into consideration the relationship between the user, the activity in which the AT is needed, and the environment throughout the process of acquiring and integrating the AT (Driscoll, Rodger, de Jonge, 2001; Cook & Hussey 1995). In *Computer Resources for People with Disabilities* (Alliance for Technology Access, 2004), the authors use the HAAT model as a way to select computer AT for PWD by providing detailed worksheets and breaking the model into informal stages where information must be gathered. The first information that is needed in the AT process begins with becoming knowledgeable of the user who will be using the AT (Behrmann, 1995). The user's abilities, limitations, general goal that the AT will help them achieve, and developmental life stage all are taken in consideration. The second area involves identifying the specific AT device needed (Behrmann, 1995). Users gather all information on different AT devices available and ones that were previously used. Other factors that go into selecting an AT are the compatibility with other technology that is currently owned, the current and future AT needs, and the environment that the device is supposed to be used. A third area that information is needed is the process it takes to acquire the AT device and train it (Behrmann, 1995). The fourth area includes repair, maintenance, and upgrade of the devices (Behrmann, 1995). The third and fourth areas of gathered information become important in the evaluation of the possible AT solutions (Driscoll, Rodger, de Jonge, 2001).

Another AT selection model where I use dimensions for my problem space is the matching person and technology model. It is a person-centered process used to match individuals with technologies (Scherer 2001). The focus is on selecting an AT device for the

user, not acquiring, training, or follow up of the AT. The model was developed as a workbook that contains series of questionnaires for both the end user and professionals that guide them through the AT selection and implementation process. The whole process and workbook focus is on the user. Unlike other models, it takes into consideration the user's personal attitudes and preferences. Using a combination of important information focus areas of the HAAT and matching person and technology models I developed five dimension areas of my problem space. They are 1) the cause of the problem, 2) my physical ability level, 3) Previous history of AT use, 4) current and future work demands that use computer technology, and 5) personal attitudes and preferences.

**The cause of the problem.** It is necessary to know the cause of the change or addition of AT for a user because it provides a clearly defined purpose that the whole AT selection process must resolve. In this specific case study, the reason why I need to find a new AT is due to a repetitive motion injury in my shoulder that I have developed using my current AT workstation. My workstation consists of me lying on my stomach on my bed while balancing on top of a pillow with my forearms. A tablet PC computer is positioned on top of a large cooling pad in front of my face. I control all of the tablets functions using a stylus in my mouth on the touch screen monitor. To reach all of the areas on the monitor, I move my head towards the area by rotating at my shoulder joint. Rotation of my shoulder joint occurs frequently each time I use the computer. This behavior became a concern to my specialized orthopedist after I injured my rotator's cuff and was required to limit time on my shoulder to the least necessary in March of 2008. A rotators cuff consists of four major muscles and tendons that connected them to the upper arm and shoulder (American Academy of Orthopedic Surgeons, 2007). A rotators cuff injury can cause tendinitis, bursitis, or a strain or tear. My specific injury was tendinitis.

Specifically, my tendons became inflamed due to overuse, which caused me to have significant pain and limited range of motion in my shoulder. Tendinitis can be treated through resting the tendons by discontinuing the motion and exercise therapy (American Academy of Orthopedic Surgeons, 2007). However, if is not treated, the injury can become more severe and results in a tear in the tendon or muscle. Once a tear occurs in the tendon or muscle, the only treatments available are surgery to repair the tear or arthroplasty (American Academy of Orthopedic Surgeons, 2007). My doctors and I believe that my workstation caused my injury was because the only activity that changed at the time was my increase in computer usage to complete my schoolwork. I had two large research term papers (total pgs. 28) due within 4 days of each other and was continuously working on the papers every day. Since I do not want my injury to become worse, I had to reduce the frequency I accessed my computer or perform exercise therapy to build up surrounding muscles. However, due to my disability, exercise therapy cannot work for my shoulders. An explanation to why my disability does not allow therapy to be a viable option will be discussed in the next paragraph. The injury did heal over time, but my orthopedist continuing to access my computer with the current methods would ruin my rotators cuff and in the future would cause a tear. A tear would immobilize my shoulder, resulting in surgery and more range of motion restriction. In addition to the current injury, in the past, I fractured both arms four times due to falls and one of my fractures was located at the top of my right arm directly below her rotators cuff. Based on my history and current condition, my orthopedist recommends a more efficient, better functioning, and less physically harmful computer workstation using different AT to prevent any further problems with my shoulder and maintain usability as long as possible. The orthopedist estimates that a complete transition to a new workstation must be made in no more than two years.

**Physical ability level.** A second dimension that defines the problem space and provides guidelines to forming a solution space is the user's disability. Taking in consideration of various aspects of a disability enables experts to develop a list of possible AT solutions for the user. In this study, I examined my disability, Arthrogryposis Multiplex Congenitia (AMC). AMC is a congenital disability that is known by the presence of multiple joint contractures. A contracture is a limitation in the range of motion of a joint. The joints affected can vary from a few to nearly all joints in the individual's body (Hall, Jaffe, Paholke, & Staheli, 1998). The contractures form during fetal development. They inhibit movement and muscle development in the fetus. The muscles surrounding the contracture are underdeveloped or nonexistent. If the muscles exist, they are often smaller in length, which limits their ability to grow larger. The areas where muscles do not exist are replaced by extra connective tissue and fat. My specific type of AMC is Amyoplasia, which is the most common type. It is often not hereditary and affects the patient's body bilaterally. Specifically, AMC affects all of my limbs, stomach, and jaw. My arms are the most affected with internal rotation of the shoulder joint, wrists flexed, elbows bent at a fuse in a 120-degree angle, and my thumbs are trapped in the palms. My legs are also significantly affected. My knees are fused straight and my ankles are fused in a 90-degree angle. I have full range of motion in my hips, which are rotated laterally out. I walk by swinging my legs outwards, using the momentum of each swing, and by balancing on my toes. My torso is moderately affected with due to my lack of stomach muscles. My back, shoulder, and neck muscles are not affected and are extremely strong. I use these areas of my body to compensate for other weaker areas and can do many fine motor control activities. My jaw is slightly affected, but is unnoticeable due to physical and speech therapy I had as a child. All of my physical abilities and limitations of my body are used as guidelines to select the computer and

AT I used in all workstations in the past, present, and in the future. For a workstation to be one I use, it has to be within my physical ability level. Listed below are my previous workstations that all take in consideration my needs as it relates to my disability.

**Previous AT Workstations.** The third dimension to the problem space is previous computer and AT knowledge of the user. Since I am the user in this study, my knowledge of computers and AT started at a young age and is above average. My first exposure to computers and a variety of AT began as a toddler in preschool where I was required to visit a senior citizen home and take basic computer and keyboarding lessons. My lesson tutor and preschool support team collaborated to develop my first adapted computer workstation. Since then, I have used four distinctively different computer and assistive technology workstations. When I was introduced to a new workstation, I received many hours of one-on-one training that enabled me to become accustomed to each different workstation and their affiliated AT equipment and programs. In addition to the adapted workstations, I took the required computer classes with my peers where I became an expert on many different programs and applications.

My first computer workstation was a desktop Apple computer that only had keyboard input. I used this workstation for three years between the ages of 5-8. A team of four physical and occupational therapists, assistive technology specialists, my preschool teacher, and my mom developed this workstation. In this workstation, I would sit in my wheelchair and use my hands and arms to perform all computer functions. My arms were placed into mobile arm supports, which enabled me to move my arms without assistance laterally and in vertical angles. In order to press each key, I had to wear custom-made hand splints that narrowed down to a point. The points were used as simulated fingers. I used the two “fingers” to press all of the keys on the keyboard. This first workstation appeared to be a good introduction to computers and assistive

technology, especially given my age and cognitive skills. When I received the computer, I did not have any formal knowledge of the alphabet or reading and writing skills. As I began learning these skills in the classroom, I was taught lessons on creating letters, spelling, and making sentences using both typing on the computer and handwriting the information. As an adult, I realize that it was good I was learning both methods simultaneously, but at the time, I felt like it was unfair and stupid. I knew that I was physically different from my classmates, but as a young child, this was very frustrating. I did not understand why I had to use both methods, especially when lessons taught for handwriting did not transfer to typing. I was also frustrated because using the computer emphasized my differences compared to my classmates. I hated looking like a robot or a machine being splinted and hooked up to metal arm holders when using this computer workstation. A drawback to this workstation, in addition to my hatred for looking different was that it required a long and tedious setup time and assistance was needed from another person. In addition, adjustments were sometimes required during usage. My aide who assisted me had to be knowledgeable about the setup and have the mechanical skills to fix problems. Finding an aide who knew how to use a computer was difficult due to computer technology being a new concept to every day consumers.

My second workstation used the same computer and desk as the previous workstation, but the arm supports and hand splints were not used. Using my motivation to be independent and not look like a robot, I increased my arm control and strength in physical and occupational therapy. Without the arm supports and splints, I accessed the computer by placing the keyboard on my lap with a sheet of Dycem, a nonslip rubber mat, underneath it. I typed using most of my fingers and using the correct finger placements for the appropriate keys. I was significantly more independent and happy that I could use this workstation physically and at the “same” skill level

as my classmates. However, unbeknownst to me, my typing skills and basic computer knowledge at the time was at a much higher level than my peers. According to my 4<sup>th</sup> grade teacher, I typed between 12-15 WPM while my peers averaged 10 WPM. I also excelled using programs that needed independent mouse and keyboard control including games such as MathBlasters, KidPix, and Mavis Beacon Typing Tutor. This workstation was used for approximately 2.5 years between the ages of 9-11.

The third workstation was drastically different from the previous two. A drastically different workstation was necessary for me to keep up academically with my peers in secondary school and to enable me to have access to a computer in all of the different classroom changes I had in a day. By 12, my typing performance with my hands hit asymptote at ~25 WPM and only lasted for 15-minute duration at that high speed, while my peers continued to improve in typing performance. Since it had been 7 years since my initial AT evaluation and the increase in technology development, I was reevaluated by a team of AT specialists, rehab coordinator, OT, and PT. In the evaluation, I was able to actually go to a computer center and demo all of the different AT available. The team ended up suggesting a laptop with a trackball for cursor control, voice recognition software (VRS) (Dragon Naturally Speaking) for typing, and a mouth stick for typing if VRS was unavailable. After the evaluation, I was trained to use Dragon for 6 months by an AT specialist from Center for Independent Living. I became an expert user of the system, but often was frustrated and quit using it due to the numerous errors it made and the instability of the microphone. In addition, the laptop I received was faulty and always was sent back to the company for repairs. Due to all my frustrations with the software and the laptop, I abandoned this workstation eagerly. Although I physically used this workstation the least but was often in the repair shop, it was used for approximately 3 years between the ages of 11-14.

My fourth “workstation” was a set of 3 mini-workstations I used simultaneously in a 9-year time frame that used interchangeable cursor control and typing methods to access a computer. Since access methods were able to work in a variety of computer setups, I was able to use independently a computer in any type of environment. This series of workstations developed while using my third workstation as a temporary way to complete my schoolwork while I waited for the software to be ordered and installed or the laptop was repaired in the third workstation. The first mini-workstation in the set of three was consisted of a desktop computer, trackball for cursor control, and my lower lip for typing. To use the computer I would bend down to the keyboard from a sitting position and push my lower lip out with my tongue to press the necessary keys to type. I became extremely efficient at this method and could type at 30 WPM for extended periods. All of my AT specialists did not like this method with my lip due to possible repetitive motion injuries in the future and suggested to me to use a mouth stick. Functionally a mouth stick worked great, but due to physical discomfort, awkward size and shape that made traveling difficult, and the mouth piece causing me to drool I declined using one, even though I was given one. When I did not have access to my desktop computer I used the second mini-workstation in the set, an electronic personal organizer. The organizer only input text and was capable of data transfer to a computer through a serial port. To type I also used my lower lip to press the keys. The third mini-workstation in the series was a basic tablet pc in which I used a stylus for cursor control on the physical screen and a stylus to press the physical keys on the keyboard. I could not use the touch screen to type due to the screen being permanently fixed in a vertical angle. In addition, the virtual keyboards available at the time were small and difficult to use. I used the tablet pc lying on my stomach on my bed propped onto my elbows. Throughout this series of workstations, I became proficient in using multiple



programs including Microsoft Office (Word, Excel, PowerPoint, Access, and Publisher), Macromedia Flash video editing, HTML web design, email, and photo and audio editing.

The fifth and current AT workstation I used was very similar to the last series of workstations. Instead of using the stylus on the keys, I used a tablet pc that converts into a slate with a stylus in my mouth for all computer functions. Similar to the previous workstation, I use the computer on my bed positioned on my forearms. I was more proficient using this setup and type consistently approximately 35 WPM. I transitioned to this specific workstation in 2008 because my previous laptop/tablet needed replaced and the improved technology was beneficial to me. Out of all of the workstations in my past, this was my most preferred one. Even though it was the most preferred workstation, there were two drawbacks to the workstation. The first one was that it was not mobile friendly and I could only use it when I lie down on a flat, clean surface. The second drawback of the workstation, which was the motivator for changing to a new one, was that it agitates a repetitive motion injury in my rotator's cuff of my shoulders. According to my specialists, I need to change the way I access a computer or the injury can cause a tear, which would require surgery fix.

**Current and future work demands that use computer technology.** The fourth dimension in the problem space was identifying the constraints that surround current and future vocational tasks that require the use of a computer for the user. Constraints included the type of tasks and the physical environment the user would use the computer. As the user, current tasks that I use the computer were essay writing, writing responses to exam essays, accessing the internet, searching and reading journal articles, checking email, inputting and analyzing data, making presentations ,writing email, writing notes or ideas during meetings or classes, and filling in short responses in documents. In the future as a professional, I will have to also develop

lectures, edit my students writing, and complete manuscript and grant writing. All of these tasks require the use of a combination of both typing and cursor manipulation. Although the exact ratio of the combination will vary depending on the task, it would be necessary for each specific task (typing/cursor manipulation) and the transition between typing and cursor control to be quick, fluid, and relatively easy. In addition to these tasks, the software and equipment should be easily updated with the current and future technology available. There were three general types of environments a computer and AT was needed: home/office, meetings/class, and traveling for conferences, etc. However, for this study I focused on the most frequently used environment, which was the home/office environment. In the home/office environment, many of the tasks listed above would be completed, but in particular, tasks that were long in duration and required focus such as manuscript and grant writing. This environment would be a permanent area that has space to lay documents and books out. It would be a private quiet area that only I and possibly a few select people would have access to the computer.

**Personal attitudes and preferences.** The fifth dimension in the problem space was the user's personal preferences for a workstation, computer, and AT. Like most individuals, various technologies can functionally work for them, but their personal preferences guide them to the specific product selected. These preferences do not always have a specific reason why they are preferred, but are just as necessary to take in consideration as a functional reason to select an AT. As a unique user and individual, I have numerous personal preferences that change depending on the specific AT solution within the solution space. These preferences can be extremely intricate and long. The interaction between the solution space and various dimensions of the problem space will be discussed after all of the dimensions of the solution space are examined. However, all of my specific preferences can be generalized into vague and all encompassing preferences.

One important personal preference that I have for future workstations is to have one that has the least physically and technologically obtrusive items in it. The workstation should take up a small space, easy physical access of all equipment, and as similar to a traditional computer workstation as possible. My biggest AT preference was to have something that I could independently use, as technologically simple as possible, and made me stand out aesthetically the least while I used it. Like when I was a child, I do not like to look different from people who complete the same tasks, even if I am doing my work with no one around. In addition, I wanted technologically simple AT because I perceive, the simple AT to have the least problems. However, if problems do occur, I perceive that the problems are easier to fix or work around because there are more alternative solutions that are possible and it is likely that there are more people will know how to fix the problem efficiently. These general perceptions and preferences were formed using my experiences with previous AT workstation solutions and are not based on any scientific credentials. They also affect what AT I select within the workstations and AT available within the dimensions of the solution space.

All of the dimensions in the problem space mold the types of workstations and AT that were included within the proposed solution space. In general, all of the possible solutions will be guided by three tenets that integrate my physical ability level with the equipment and software selected and used. First, there was minimal arm or hand manipulation in accessing the computer. Second, my torso and vocal chords were the main body parts used to interact with the AT. Third, my ability to use both my intellect and resources in my environment will be used to come up with adaptations. Additional aspects of the problem space reflected in specific dimensions of the solutions. They will be discussed in the description of the dimension.

## **Solution Space**

The solution space consists of all possible AT solutions currently known available for the problem and corresponding dimensions that affect the success rate of the solutions. Although the solution space consists of all possible solutions and dimensions, it is impossible to know all the possibilities due to the broad spectrum of technologies with multiple customizations currently available and the ever-changing advances in new technology developed daily. For this thesis, I discuss the most common possible solutions and dimensions as it relates to my specific problem space. In the solution space, there are six general types of AT solutions currently available. The six types are eye gaze interaction, head tracking, brain computer interface (BCI), voice recognition software (VRS), stylus/mouth stick/head stick typing, and general cursor manipulation using external devices. A basic overview of each general AT type is discussed below.

Eye tracking is an AT that tracks a user's eye gaze for cursor control on a computer screen (Majaranta and Räihä, 2002). Cursor control is used for desktop selections and typing (Hansen, Hansen, and Johansen, 2001). In order to type, an onscreen keyboard is used. Numerous types of onscreen keyboards are available that have a variety of options that can be customized to the user's needs (Majaranta and Räihä, 2002). Head-tracking technology is similar to eye tracking but instead of using eye gaze, the user's head movements are what manipulate the cursor for desktop selection and typing with an onscreen keyboard (Hansen, Tørning, Johansen, Itoh, and Aoki, 2004). A BCI is a type of AT that sends messages to the computer for cursor manipulation and letter selection without the use of peripheral nerve and muscle pathways from the brain, but via the user's brain signals (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). Desktop selections and typing with an on screen keyboard is often completed by manipulations of the cursor on the desktop. The process from a

user's brain signals to cursor control is complex and will be discussed in further detail later in the thesis. Voice recognition software transcribes the user's verbal dictation into text on the computer screen and/or desktop commands (Koester, 2001). Stylus/finger/mouth stick/head stick typing uses a one digit-pointing device that physically presses each key on a hard or virtual touch screen keyboard by (Alliance for Technology Access., 2004). Different keyboard setups are available, including virtual ones that have predictive text (MacKenzie and Tanaka-Ishii, 2007). Basic external hardware such as mouse and trackball technologies typically are used for only cursor control for desktop selections, but for PWD they are considered AT when paired with an onscreen keyboard for text input (MacKenzie and Tanaka-Ishii, 2007).

The dimensions in the solution space provide an organized framework that enables a comparison among the six general AT based on factors that affect their success rate on the problem and are necessary to consider when examining each solution. The number of dimensions within one solution space can vary depending on how specific one needs to examine each solution. Additional dimensions can be discovered during and after examining all of the possible solutions. For this thesis, I examined 12 dimensions within the total solution space. The dimensions selected were based on the specific methodologies an AT solution enables me to access and use a computer. The number of dimensions for each at varies depending on specific characteristics of the AT. The different dimensions are mode of user input into an AT, level of technology used, text input methodology, typing productivity (speed, # of errors), cursor control methodology, keyboard type, key selection, keyboard character layout, physical hardware keyboards, virtual keyboard platforms, eye gaze interaction keyboard platforms, predictive text (t9, word). The first five dimensions listed are in all AT solutions.

The following six dimensions are in at least one of the AT solutions, but not all six.

**Mode of user input.** The mode of user input describes what particular part of the user's body/mind provides information to interact with the computer. The different possibilities in this dimension are eye gaze (AT: eye gaze), head movements (AT: head tracker), voice (AT: VRS), brain signals (AT: BCI), mouth movements (AT: mouth stick), and any external body part that the user has ability to move and stable control hand, foot, chin, nose, etc (AT: trackball, mouse). Depending on the user's body, different body parts coupled with the advances in technology may be easier to access a computer than the originally planned way to use a technology. (MacKenzie and Tanaka-Ishii, 2007).

**Level of technology used.** Assistive technology is defined as any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of people with disabilities (Individuals With Disabilities Education Act 1991). Due to this large, all encompassing definition, AT is divided into different types and levels. For this thesis, I examined only computer AT and the levels found in this category. The levels of AT are spread across a continuum beginning with no-tech, low-tech, medium-tech, and ends with high-tech. According to Blackhurst and Lahm (2000) no-tech AT are ones that that make use of procedures, services, and existing conditions in the environment that do not involve the use of devices or equipment. Examples of these AT include using an assistant to access a computer, working with a physical therapist to strengthen one's body to use traditional computer hardware and software. Low-tech AT solutions are ones that are physical items that are not electronic (Blackhurst and Lahm, 2000). Examples of low-tech solutions include adapted hand splints, mouth sticks, and head sticks that select letters on a keyboard, keyboard/mouse stands. Medium-tech AT are simple electronic or mechanical devices that do not have sophisticated computer microchips

(Blackhurst and Lahm, 2000). AT in the medium-tech category includes tape recorders, alternative ergonomic keyboards, and mice/trackballs. High-tech solutions are those that utilize complex, multifunction technology and usually include a computer and associated software (Blackhurst and Lahm, 2000). User input for high-tech solutions have significantly more steps and alterations to process into a finalized computer output than traditional computer technologies. Examples of high-tech solutions are touch screens, voice recognition software, voice synthesis, brain computer interfaces, onscreen keyboards, and eye-gaze interaction.

**Text input methodology.** There are three different ways users input text into a computer. The most common way is by accessing a physical keyboard and directly selecting each key by pressing down on it (MacKenzie and Tanaka-Ishii, 2007). A second way to input text is by cursor control on an onscreen keyboard (MacKenzie and Tanaka-Ishii, 2007). For both physical and onscreen keyboards, there are various platforms and layouts available to fit specific types of users (Go and Endo, 2008; Mackenzie, Zhang, and Soukoreff, 1999). These keyboard platforms and layouts and the methods available for cursor control using AT will be described in further detail in separate dimensions of the solution space. The third way to input text is by verbally dictating the specified text into voice recognition software (MacKenzie and Tanaka-Ishii, 2007).

**Typing productivity.** Typing productivity measures the text inputs typing speed and number of technology errors made while inputting text. Both measures of productivity are used to provide a standard of comparison in typing efficiency among the different technologies (Man and Wong, 2007). The comparison provides user's an initial prediction to how efficient each technology is. Typing speed is measured in the number of words or characters output per minute (WPM or CPM). This measurement includes the time it takes to fix user made errors. Users

made errors are input errors that the user unconsciously made and the resulting output reflects these errors (Yechiam, Erev, Yehene, & Gopher, 2003; Soukoreff, & MacKenzie, (2003). The number of technology errors made is defined as output that is different from what the user input and is caused by problems in the technology (Riemer-Reiss, & Wacker, 2000).

**Cursor control methodology.** Three different methods are available for cursor control. The first method is using a traditional pointing device that moves a cursor on a screen. Selection of an item is completed using buttons or switches that are programmed to a specific click action. The second method is by directly moving a cursor to the specified area on the screen. Direct movement is possible using a touch screen, voice recognition software, eye gaze interaction, and specifically programmed BCI's. Selecting an item can be completed using three different methods. First, a switch can be used to make various selections by a different part of the body (Bates, 1999). Second, a dwell feature can be added to the cursor control. Dwell clicking occurs when the cursor lands and stays idle on top of the item needed for selection for a specified time (Jacob, 1991). Different types of clicks can be programmed using different durations of time the cursor is idling. The third method used to select an item using direct movement is by providing a direct command through the user's input that are preprogrammed into the computer to make a selection when the cursor is directly moved to the specific spot wanted.

The following dimensions are ones that pertain to only AT that use keyboards. Keyboards come in a variety of different options. The differences can be very broad to the very specific. Each different option is its own specific dimension within the solution space.

**Keyboard type.** The largest difference among keyboards is how the user interacts with the keyboard. The interaction with the keyboard depends on the "physical" keyboard put in front of them and is the broadest dimension in keyboard interaction. The physical keyboard can be



either a physical hardware or a virtual one that is a software component to a computer. A physical hardware keyboard is a separate attachment piece from the actual computer and each physical key represents a specific set of characters (Yamada, 1980). It is also the most common type of keyboard. A virtual keyboard is a software component to text input (MacKenzie and Zhang, 1999). There are four different ways the software component produce virtual keyboards. The most common virtual keyboard displays a keyboard layout on the screen monitor where characters are selected by various input devices using cursor control. A similar virtual keyboard is also one that has a keyboard layout on the screen monitor and has an overlay on the screen that makes it a touch screen. Another virtual keyboard is a physical keyboard whose keys have electronically changeable displays integrated in the keypad. The last type of virtual keyboard detects human hand and finger motions in a specific area of a keyboard that is optically projected onto any surface. (MacKenzie and Zhang, 1999).

**Key Selection.** A second difference in how users interact with a keyboard is in the way a key is selected. Users can select a key on a keyboard four different ways: direct selection, point and click, point through a zooming text, and switch scanning.

In physical keyboards, touch screen, and optically projected virtual keyboards, every input using the keyboard is input by direct selection of the character. In direct selection, the user reaches and presses the specific key(s) wanted. Point and click key selection occurs on virtual onscreen keyboards that toggles between 2-3 different key changes. An example of a key change is when the shift key is pressed the screen toggles to the same key placement, but with capital letters instead of lowercase letters. Key selection is completed by moving the cursor across the screen to the specified key and selected by a click using a type of input device. In pointing through a zooming text key selection, a list of characters flow across the screen in a specific

order (Ward & Mackay, 2002). Users then point the cursor toward the target character and the target character and its encompassing area becomes larger and flows toward the exact center of the screen. The target character is selected once it and its encompassed area around it pass through a crosshair in the middle of the screen. Once a letter is selected, the process begins again and a new character list begins to zoom toward the cursor (Ward & Mackay, 2002).

Switch scanning key selection uses a virtual onscreen keyboard and a third party device to make selections (Brewster, Raty, & Kortekangas, 1996). In this method, each character, or group of characters on the keyboard are scanned in an organized order by being highlighted for a set time until all the characters have been highlighted. To select a character, users must activate a switch using a third party device (mouse click, button) when the target character is highlighted. Once the target is selected, the scanning begins again on the keyboard. If groups of characters are scanned at a time, the newly selected group of characters will change into a new screen layout that separates the characters into individual options to scan through. (Brewster, Raty, & Kortekangas, 1996).

**Keyboard character layout.** There is a variety of keyboard character layouts for physical and virtual keyboards. Each layout has specific features that provide it with advantages and disadvantages for the user. The most common layouts for a traditional typist and layouts made specifically for the six general AT solutions are discussed.

*QWERTY.* The most popular keyboard layout is QWERTY. QWERTY represents the top 6 letters of the alphabetic keys in the layout. It was created by Christopher Sholes for the construction of typewriters and was one of the first layouts accepted by the mainstream public (Yamada, 1980).

The motivating factor behind this design layout was to increase typists typing speeds on typewriters by stopping the key type bars that were near each other from clashing and jamming when typed in succession (Yamada, 1980). Although current technology does not use type bars or have the problem of type bars clashing and jamming, it is still the most commonly accepted keyboard layout. It also is the standard layout provided by Windows, Apple, and Linux operating systems.

***Dvorak.*** The Dvorak layout was patented by Dr. August Dvorak and Dr. William Deale in 1932 and was designed to replace the QWERTY layout (Dvorak, & Dealey, 1936). The Dvorak layout focuses on placing the keys in a location based on the relationship between each finger's movement and a combination of the frequency each key is used and frequent letter combinations (Dvorak, & Dealey, 1936). Given these constraints, the most popular letters are in the home row and in the center of the keyboard. In addition, most letters used to spell out are pressed by alternating hands (Dvorak, & Dealey, 1936). Dvorak is the second most common keyboard layout found and comes as a standard option in Windows and Apple operating systems (MacKenzie and Tanaka-Ishii, 2007).

***FITALY.*** A third keyboard layout is FITALY, which was created by Jean Ichbiah of Textware Solutions. FITALY is a keyboard layout made specifically for on screen stylus or touch based input on Windows Mobile, Windows Tablet, and Palm devices (Mackenzie, Zhang, and Soukoreff, 1999). The name comes from the letters found in the second row of keys. The layout is designed to optimize text entry by reducing the physical distance for the one digit input (typical keyboards use 10 digits) from pressing one key to another key. The size of the layout is five rows and six columns. In addition, the keys are arranged with the most frequently used keys in the English language closest to the center. (Mackenzie, Zhang, and Soukoreff, 1999).

**Physical hardware keyboards.** Physical keyboards come in multiple shapes and sizes depending on the user's specific needs. The standard "full" desktop sized alphanumeric US Windows keyboard has 104 keys that are laid out on a horizontal field and are raised  $\frac{3}{4}$ " off the base (MacKenzie and Tanaka-Ishii, 2007). The keys include alphabetic characters, punctuation symbols, numbers, and function keys. Keyboards made for laptops, netbooks, and small technology devices are smaller and often do not have the numeric pad. (MacKenzie and Tanaka-Ishii, 2007).

There are also ergonomic physical keyboards available. Ergonomic keyboards are designed to minimize muscle strain in a user's hands, wrists, arms, neck, and back by providing a natural typing posture for a user. Their purpose is to relieve and reduce repetitive motion injuries for typists who have full function of their arms and hands. Only a few ergonomic keyboards will be discussed since the typist, myself, does not have full functioning arms and hands that input text. One type of ergonomic keyboard is a split-key keyboard. A split-key keyboard enables users type at different angles spread out on the horizontal axis by separating the keys into two or three different groups (Alliance for Technology Access, 2004). The groups of keys can be either fixed permanently at different angles or adjustable. Another type of ergonomic keyboard is a contoured keyboard. A contoured keyboard allows users to type at different vertical angles by increasing height in the center of the keyboard (Alliance for Technology Access, 2004). The keys are usually separated and placed in two different depressions. This keyboard configuration is beneficial because it requires minimal arm and wrist movement once the hands are placed on the keys.

Other types of physical keyboards include chorded and one-handed keyboards. Chorded keyboards allow users to enter characters or commands by pressing a set combination of keys

together (Lyons, Starner, Plaisted, Fusia, Lyons, Drew, & Looney, 2004). The number of keys on a chorded keyboard varies, but is significantly less than a standard keyboard. A one-handed keyboard allows users to type using only one hand. Chorded keyboards are a type of one-handed keyboard available. Another one-handed keyboard available is made by Maltron. Maltron's one-handed keyboard is ergonomically shaped and has a key layout specifically made to use with only one hand (Alliance for Technology Access, 2004). The shape and layout takes in consideration that a one handed user has fewer digits to use and requires less finger span between keys (MacKenzie and Tanaka-Ishii, 2007).

**Virtual keyboard Platforms.** Keyboard layouts such as QWERTY and Dvorak are available on a variety of virtual keyboard software programs. Both layouts come standard on all Windows and Apple OS onscreen keyboards in the accessibility section of the control panel. Depending on a user's specific needs, a third party onscreen keyboard program is needed for access. There are two different types of platforms discussed: platforms with their own unique keyboard layout and platforms that use the two most popular keyboard layouts: QWERTY and Dvorak. A general description of each keyboard layout is discussed later. Platforms with their own unique keyboard layout are typically used for specific text input devices. This thesis examines platforms specifically for eye gaze interaction: GazeTalk, Dasher, and StarGazer (Majaranta and Räihä, 2002; Hansen, Skovsgaard, Hansen, & Møllenbach, 2008). Two of the numerous programs that use the platforms that use QWERTY and Dvorak layouts available are WiViK and Hot Virtual Keyboard.

**WiViK.** WiViK is a popular on screen keyboard program used by PWD, which was developed by Prenke Romach (MacKenzie & Zhang, 1999). This program is preferred because it has simple point and click selection of keys, options for predictive text, and two of the most

popular keyboard layouts are used: the traditional QWERTY keyboard and DVORIK keyboard. In addition, the keyboard can be resized and character keys can be resized and color-coded to fit each user's need. (MacKenzie & Zhang, 1999).

***Hot Virtual Keyboard.*** Hot Virtual Keyboard is a virtual on-screen keyboard made by Comfort Software Group that can be completely customizable. More than 65 different templates come standard with the software, but there is the option to modify the keyboard's background, color and font of the keys, sounds of different key groups, layouts, languages used, and assigns certain keys to specific actions. In addition, gestures are programmed to change case or insert spaces and word auto-complete enables a more productive typing performance.

**Eye gaze interaction keyboard platforms.** Any onscreen keyboard can be used with eye gaze interaction text input, but there are keyboard platforms made specifically for this AT. GazeTalk, Dasher, and StarGazer are three types of platforms made. Although, these platforms are made specifically for input using eye gaze interaction, they can receive input using other input devices. In addition, all of these keyboards have a feature that uses letter/word prediction methods to improve typing speed.

***GazeTalk.*** GazeTalk is a text entry system with a restricted keyboard developed by The Gaze Group at The IT University of Copenhagen (Aoki, Hansen, Itoh, and MacKay, 2006). The purpose of GazeTalk is that it enables the use of eye gaze tracking technologies with low spatial resolutions. The layout consists of 10 different boxes (keys) that contain a letter or word or is a pathway to a set of letters or words that are not currently visible. Once a box is selected, the screen replaces the boxes with a set of predicted letters or words based on the previous selection. Besides text entry, GazeTalk is a web browser, music/video player, PDF reader, and can provides speech output of the user's input text. (Aoki, Hansen, Itoh, and MacKay, 2006).

***Dasher.*** Dasher is an on screen keyboard program developed by the Inference Group at Cambridge University that is conceptually very different from standard on screen keyboards (Aoki, Hansen, Itoh, and MacKay, 2006). Instead of the standard point and click selection interface of most on screen keyboards, Dasher has a zooming interface. Specifically, what occurs is that a letter/character stream of all of the keys on a keyboard flow from one of the screen's borders to the opposite side in a straight line. Each character is inside an alternating color-coded box. To select a character, the cursor must be pointed towards the character box. As the character approaches the center of the screen, the surrounding character boxes get smaller while the the box around the character that is wanted gets larger and automatically selected as it passes the center crosshair. After the character is selected, the next predicted letter or word appears the largest in the next stream of characters. (Aoki, Hansen, Itoh, and MacKay, 2006).

***StarGazer.*** StarGazer is a 3D onscreen keyboard interface made specifically for gaze-based interaction by The Gaze Group at the IT University of Copenhagen (Hansen, Skovsgaard, Hansen, & Møllenbach, 2008). In this interface, all of the characters are in a circle and to select a target, a continuous pan and zoom is used. Once a target is selected or zoomed through, a new circle appears that contains characters selected using its predictive text entry system. The StarGazer typing system minimizes the interference of noise-imposed input that comes with using eye gaze interaction. This allows StarGazer to operate with webcam-based eye trackers or small displays. The system is designed as an experimental interface for text production. (Hansen, Skovsgaard, Hansen, & Møllenbach, 2008).

**Predictive Text.** Predictive text is the ability for a software program to predict the next letter, character, or word that will be input into the computer. Predictive text enables user to

increase their text input productivity since less time is spent searching for or selecting characters. Predictive text occurs in three different methodologies: T9, character, and word bank.

**T9.** T9 means *Text on 9 keys*, and is a predictive text technology for mobile phones, developed by Tegic Communications. 3-4 letters are grouped together on one key. Words are entered by a single key press for each letter and by searching in an internal dictionary for all words corresponding to the sequence of key presses. The words are then ordered by their frequency of use in a given language. As more words are input by the user, the program reorders the words to the users most frequently used words. The dictionary can be expanded to add more words for future recognition. (James & Reischel, 2001)

**Character.** Character predictive text technology suggests to users the next character that is most likely wanted to type by placing the predicted character in a physically more accessible place. The suggestions come from the initial characters selected. (Darragh, & Witten, 1991).

**Word bank.** Word bank prediction is a technology that produces a list of possible predictions for the next word that is most likely wanted to type. The word bank list is developed from the previous words typed in the output text and the characters pressed at the beginning of the word. (Darragh, & Witten, 1991).

### **Detailed Description of six General AT.**

**Eye gaze interaction.** Current eye gaze technology recognizes eye movement of a user using a camera that shines a beam of infrared light onto the eye that reads the corneal reflection and pupil outline of an eye (Majaranta and Rähä, 2002). The relationship between the pupil and cornea changes depending on where a user is looking in their visual field. This relationship is measured by the camera and can be used to determine where the user is looking on the screen using neural networks. The changes in gaze on the screen are what moves the cursor and enables



selections to be made. Eye gaze interaction is considered a high tech AT solution due to its use of complex multifunction technology (Blackhurst and Lahm 2000).

*Usability and productivity of eye gaze.* Eye Gaze is an AT that many individuals with ALS, quadriplegia, and severe CP use as their chosen AT input method for cursor control and typing (Majaranta and Riih , 2002). Typing productivity using eye gaze interaction varies depending on the onscreen keyboard platform selected. The variance is due to the inability of the camera and the computer software to track fine details of eye movement on the screen and its difficulty to extract excess visual noise from the user’s environment. The initial typing studies using eye gaze interaction used onscreen keyboards with the traditional QWERTY layout (WiViK). Users had to look at each character to move to the specific key. Selecting the key once the cursor was moved to the key was completed using a dwell click. The average WPM using the traditional QWERTY layout was 7 WPM (Stampe & Reingold, 1995). John Paulin Hansen and his research team at IT Copenhagen explored the possibilities of eye gaze typing, by developing GazeTalk and StarGazer specifically for eye gaze typing that took into account lack of fine detail selection.

John Paulin Hansen’s team discovered that typing using GazeTalk who were novices to the software and eye gaze typing (total of 3 hours of use) had a typing speed of 6.22 WPM (2004). However, in 2001, typing using GazeTalk and eye gaze by experienced users (>10 hours of use) could reach between 10-20 WPM once they adjusted to the dynamic layout and word prediction feature (Hansen, Hansen, and Johansen). The large difference in the typing productivity in this study was due to the words in the available word prediction dictionary.

The same team, who developed GazeTalk, developed onscreen keyboard software called StarGazer. StarGazer was made to decrease the need for fine detail selections using an eye

tracker by having the characters in a non-rectangular shape. In a study, using StarGazer as the onscreen keyboard for eye gaze typing and users who had little to zero experience with eye trackers and zero experience with StarGazer the typing speed was 8.16 WPM (Hansen, Skovsgaard, Hansen, and Mollenbach, 2008).

The onscreen keyboard Dasher is a possibly program that is beneficial for eye tracking typing due to it producing continuous character selection and not the traditional point and click character selection. Cogain Institute examined the typing speed of Dasher in the Japanese language by training novice users of eye gaze interaction without disabilities how to type using Dasher over a week period. By the end of the week, the users on average could type 46 CPM in the Japanese language that uses Hangul characters (Aoki, Hansen, Itoh, and MacKay, 2006). The Japanese CPM was converted to standard European Language using alphabet letters and ended up having a typing speed of approximately 23 WPM.

***Head tracking.*** Head-tracking technology tracks an individual's head or facial movements and translates them to cursor movements on the screen (Betke, Gips, & Fleming, 2002). There are three basic methodologies to use head tracking: camera that translates exact features of the user's face and head (Head Master), an infrared camera with reflective dots located on a moveable body part, and a long rang optical pointer that has a light sensor attached to an individual's head (LROP). Head tracking is considered a high tech AT solution due to its use of complex multifunction technology. All head tracking devices use cursor control to type with on screen keyboards. In addition, cursor movement is manipulated by head movements of the user. (Betke, 2009).

***Usability and productivity of head tracking.*** The typing performances of all three methodologies were examined by Angelo, Deterding, and Weisman (1991). Angelo, Deterding,

and Weisman used eight different individuals with severe motor disabilities to take a typing test using all three methods. In the typing test, participants only used a QWERTY keyboard layout, selected each key using dwelling, and did not use any predictive text. Each method used the onscreen keyboard software that was developed specific to the methodology. On average, researchers found that the Head Master and the LROP had the highest average typing speeds. The Head Master typing speeds ranged from 15- 40 WPM with an average at 30 WPM and the LROP ranged from 20-35 WPM with an average at 30 WPM. The infrared camera with reflective dots methodology's performance varied from 5 – 20 WPM with an average at 12 WPM. Similar typing performances were seen in most of the literature that used a QWERTY onscreen keyboard layout (Man & Wong, 2007).

Although the infrared camera with reflective dots methodology had the lowest average typing speed, it, and upgraded advances in technology similar to the Head Master are the most common head trackers used currently (Bates, 2006). This is due to the ease to setup the system and they have become the least physically obtrusive methods. Nonintrusive AT is more likely to be used and not abandoned by users compared to ones that are physically obtrusive to their bodies or personal space (Hemmingsson, Lidström, & Nygård, 2009). The Head Master currently only requires a camera setup on the monitor and a small wireless clip placed around the users head (Angelo, Deterding, and Weisman, 1991). The other method only requires a camera that plugs in through a USB port and a flat, tiny reflective dot that sticks on the user (Bates, 2006).

The only published research using a head tracker for typing with a non-QWERTY onscreen keyboard layout found was by Hansen, Torning, Johansen, Itoh, and Aoki (2004). In this study, researchers used GazeTalk as the onscreen keyboard with the head tracker that uses a

camera and reflective dots. Typing performance for the head tracker using GazeTalk and novice users of alternative input AT was 6 WPM. Although this is a low performance rate, it must be taken in consideration that GazeTalk was developed around constraints associated with eye tracking and not head tracking (Hansen, Torning, Johansen, Itoh, and Aoki, 2004). The researcher's purpose for using head tracking with GazeTalk was simply to test whether GazeTalk could work efficiently with a head tracker and to form a comparison performance rate between different alternative input ATs.

***Brain computer interface (BCI).*** A BCI is a communication system in which messages or commands that an individual sends to the external world do not pass through the brain's normal output pathways of peripheral nerves and muscles, but through brain signals (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). Current brain signals that are used in BCIs used to type on a computer are P300, visual evoked potentials, and slow cortical potentials (SCPs). Beta and mu rhythms are also signals that are used with BCI's, but the research with these signals focus on artificial limb control. There is a four step general process to forming text output or cursor movements on the screen from the brain signals. First, the specific brain signals that carry the users commands are acquired from the scalp or the surface of the brain or from specific cortexes of the brain. Features of these signals are then extracted, analyzed, and recorded according to size, location on the brain, and function of the signal. These feature extractions that still hold the user's specific commands are translated into an algorithm that the computer understands. Once the computer can read the newly translated algorithm of the messages from the user, the messages text output or cursor movement is completed (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). BCI is considered a high tech AT

solution due to its use of complex multifunction technology (Blackhurst and Lahm 2000). All typing is completed using an onscreen keyboard.

The methodology used to acquire brain signals to send to the computer can either be invasive or noninvasive. Invasive BCIs acquire brain signals from the surface of the scalp or brain and from specific cortexes of the brain (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). In order to acquire signals from the specific cortexes of the brain, one must have surgery to implant electrodes on the different parts of the brain underneath the skin that can send the signals to another computer source for data extraction and translation. Noninvasive BCIs acquire brain signals from the exterior scalp of the brain by placing different electrodes that touch surface of the user's head (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). Previously the electrodes were connected to another computer source for data extraction and translation by wires, but new products are on the market that are wireless.

*Usability and productivity of BCIs.* One of the first BCIs examined for typing performance used visual evoked potentials. Sutter (1992) recorded VEP signals that were produced over the visual cortex when users were given brief visual stimuli. The visual stimulus was a video screen that displayed 64 alphabet letters and symbols organized in an 8 x 8 grid. Users would look at the symbol they wanted to select and the computer would store the VEP amplitude of the symbol it predicted the user wanted. To be accurate of the specific symbol the user wanted to select, the system compared VEPs of alternative symbols that were flashed in alternating color patterns 40-70 times/second. Both users with a disability and users without a disability were capable of typing 10-12 words per minute. However, for these users, the VEPs were measured using scalp implants and not surface level electrodes.

Perelmouter and Birbaumer (2000) used slow cortical potentials (SCPs), to select a letter or letter combination by a series of two choice selections. The letters displayed for selection began by first separating the alphabet into two halves and selecting the half that was wanted. The alphabet would then be divided into quarters, and eighths until only two letters were left. An increase or decrease in the voltage of the SCPs compared to the users baseline SCP voltage determined whether the top half or bottom half was selected. To confirm the correct half was selected, the screen provided an option to go back a step and make a new selection. The typing rate in this method was on average relatively slow with users writing 0.15 -3.0 letters/minute or 2-36 words per hour.

Doncin and Smith (1970) discovered that a P300 signal BCIs has a typing performance rate of 1 WPM or 4-7 CPM. Although, this is a slow rate, p300 signals were liked due to the non-invasive accessibility of receiving signals through a cap placed on the users head and there is not any initial training required for users. Symbols were selected by counting the number of times the row or column containing the desired symbol flashed on a 6 x 6 grid in a trial of 12 randomly patterned flashes. When the user counted the row or column, the p300 produced a spike in the evoked potential. These signals come from the parietal cortex.

Mu rhythms and beta rhythms come from the sensory motor cortex of the brain. They are easiest to access and control voluntarily (Wolpaw, Birbaumer, McFarland, Pfurtscheller, Vaughan, 2002). To control mu and beta rhythms, users imagine motor movements in different parts of their body. The motor movement imagined is linked to a specific cursor direction on the screen. This link enables full computer access. Although complete cursor control is available to users, which would hypothetically make typing using a virtual keyboard possible. However, current research does not investigate this problem.

Invasive BCI's have been previously researched mainly in animal studies due to the high risk of performing a new type of surgery on humans. In the animal studies, monkeys are mainly used due to their similarity to human brains and physical functions of their body. In one study by Santhanam, Ryu, Yu, Afshar, Shenoy (2006), electrodes placed on the dorsal premotor cortex of monkey brain's enabled independent control. The monkeys were able to make efficient and accurate selection at a speed of 6.5 bits/second. This high speed provides promising news for typing for humans using electrodes on a brain cortex. A translation of this speed into a typing speed would be approximately 15 WPM. This is a significantly faster speed than using previous BCIs. Current research by Cyberkinetics is examining the possibilities of typing using implantation of electrodes on a human brain similar to the monkey studies with people with high spinal cord injuries.

***Voice recognition software (VRS).*** Voice recognition software (VRS) is software that converts an individual's vocal output into text or actions. It is trained to learn the nuances of one specific individual's voice. VRS computes and outputs the text or commands using a hidden Markov model (HMM) (Karat, Horn, Halverson, & Karat, 2000). A HMM is a complex system that has many categories or states that are interconnected and that produce an end result. In a HMM the information initially input into the system is divided into many categories/states that are not visible to the user. These invisible or hidden states are never explicitly known to the user using the software, but are translated into a visible output (Karat, Horn, Halverson, & Karat, 2000). In this case, of VRS, the output would be text on the screen or an action occurring on the computer screen. VRS is considered a high tech AT solution due to its use of complex programmed technology (Blackhurst and Lahm 2000). All cursor control and text input is made by verbal commands (Karat, Horn, Halverson, & Karat, 2000).

*Usability and productivity of VRS.* Due to the model used in VRS the typing performance is specified into two different terms: accuracy and speed (Koester, 2001). Accuracy takes in consideration all of the corrections (insertions, deletions, and substitutions) needed to make the text read exactly how it was said. It is measured in word error rate (WER) (Koester, 2001). Speed is how fast the input is translated into output and measured in words per minute.

According to the developers of Dragon Naturally Speaking Professional 11, a type of VRS, a user should be able to type as fast as 160 WPM and an accuracy rate of 99% (Zick and Olsen, 2001). This claim of a high typing speed and accuracy began in version 4. However, in case studies, this does not appear to be the typical case. In a study with 24 experienced DNS users with only physical disabilities, the typing speed while using DNS ranged from 3-32 WPM with an accuracy rate between 72-94% (Koester, 2003). In another study, novice and advanced physicians who used DNS transcribed their patient's medical notes. The average typing performance for novice and advanced users was higher than the study using PWD. The novice user's performance was at 40.6 WPM and accuracy at 97.7 %. The advanced user's performance was at 64.2 WPM and 99.1% accuracy. (Zick & Olsen, 2001). Garrett completed her master's thesis using five novice physically disabled HS student participants who were trained to use DNS for essay responses. These students all were familiar to word processing and the lowest intellectual writing level was at 7<sup>th</sup> grade. The typing performance varied significantly among the participants. The slowest typing speed for a participant averaged 27.8 WCPM and accuracy was 74.2%. The fastest typing speed from a participant was 112.7 WCPM and accuracy at 88.3%. Out of all five participants, the highest average accuracy rate achieved for one participant was 92.5%. Out of all three case studies, none was able to replicate the developer's



typing speed of 160 WPM. However, in one case by Zick and Olsen (2001), advanced users of DNS were capable of having a 99% accuracy rate.

*Stylus mouth stick/head stick typing.* Typing using a one digit 3<sup>rd</sup> party accessory provides users the ability to access any computer that has a traditional hard keyboard and some touch screen keyboards. The third party accessory can be used by the user in his or her mouth or physically attached to a body part, most often one's head or chin. Typing using a third party 1-digit accessory is becoming more common due to the touch screen mobile phones that use one's finger. Stylus/mouth stick/head stick text input is a low-technology assistive device because it is used on current physical keyboards (Blackhurst and Lahm 2000).

*Usability and productivity of one digit typing performance.* The most current research using one digit typing is on touch screen mobile phones using a stylus or finger. Castellucci and MacKenzie (2011) examined typing performance of six different layouts on Android phone devices using physically able-bodied participants. They found that the best typing speed came from using a QWERTY layout (21.4 WPM). The next best speed was using ShapeWriter, shape recognition software at 20 WPM. The slowest typing input among participants was DioPen, a handwriting recognition software at 6.1 WPM. Similar results in typing performance using the QWERTY layout and a stylus was also seen by Goldstein, Book, Alsio, and Tessa (1999), Go and Endo (2008), and Bao, Pierce, Whittaker, Zhai (2011).

Other research using one digit typing has focused specifically on participants with physical disabilities. Koester and Levine (1996) examined typing performance of participants who are physically able bodied and ones who have had spinal cord injuries and used alternative typing methods. In this study, participants had to type on a standard computer keyboard using a mouth stick or one digit hand-typing splint. The SCI participants had on average a typing speed

of 20 WPM, which was significantly higher than physically able-bodied participants whose typing speeds were only 12 WPM.

*General cursor manipulation using external devices.* Individuals who cannot utilize a keyboard efficiently, but can maneuver an external device such as a mouse, trackball, or joystick proficiently can use an onscreen keyboard to input text to the computer. Often the onscreen keyboard used is the basic QWERTY keyboard that is provided in all standard issue OS. The keyboard does not allow any customizations so many PWD who rely on an onscreen keyboard choose to use an alternative one that allows them to customize. Although QWERTY keyboards are typically used, any type of keyboard or layout can be used if it only requires cursor control. General cursor manipulation using external devices is considered a medium-technology due to its use of simple mechanical devices that do not require a computer chip or required programs or software to use the AT (Blackhurst and Lahm 2000).

*Usability and productivity using an external device.* Three studies examine thoroughly the use of a mouse or trackball with an onscreen keyboard for text input. The first study examined typing with a traditional mouse using GazeTalk keyboard. In this study by Hansen et al (2004), twelve able-bodied users typed sentences from the tales of Hans Christian Anderson in Danish using GazeTalk and a traditional mouse for two consecutive days. The participants were novices to GazeTalk, which resulted in an average typing speed on day 2 to be 7.45 WPM. Although these are novice users, Hansen et al (2004) predicted in a model that expert users of GazeTalk would increase their average typing speed to be 10.1 WPM.

The second study has one able-bodied participant input text using a trackball as the external device to control the computer cursor and two different onscreen keyboards: Trackball EdgeWriter and WiViK (Wobbrock, Myers, 2006). Trackball EdgeWriter is a stroke based text

entry method. Users produce patterns of letters by moving the cursor towards four corners of a virtual EdgeWrite square and connecting the corners together. The connections of the corners produce a character on the screen. WiViK is a traditional QWERTY based keyboard. In addition to measuring typing performance between the two onscreen keyboards, researchers explored performance influenced by word prediction features. Typing performance for WiViK without word prediction was 8.04 WPM, Trackball EdgeWriter without word prediction was 8.22 WPM, WiViK with word prediction was 11.82 WPM, and Trackball EdgeWriter with word prediction was 12.09 WPM (Wobbrock, Myers, 2006).

The third study has one participant with a motor impairment due to a spinal cord injury inputting text using a trackball and Trackball EdgeWriter as the onscreen keyboard program over a period of ten weeks (Wobbrock and Myers 2006). By the last week of testing, the participant's typing speed reached a plateau maximum using Trackball EdgeWriter at 5.28 WPM. Although this was significantly slower than the previous study using the Trackball EdgeWriter, the participant's typing speed was still higher than his traditional input methods using a QWERTY onscreen keyboard (4.6 WPM) (Wobbrock and Myers, 2006).

**Assistive Technologies used in Current Study.** Six different AT and variations among them exist as possible methodologies to input text into a computer for people with disabilities who lack arm and hand control. Each AT has specific characteristics that make them different from each other in both quantitative (typing performance) and qualitative data. This particular study chose three of the six AT to examine thoroughly AT for an individual to select. The three AT I chose to examine in this study are BCI, VRS, and head tracker. The selection of the three AT was based upon geographical availability of the AT at my university campus and not on actual AT possibilities for me. Due to the complex nature of each AT, the type of technology

used to make the AT function, and the varying dimensions in each of the AT, a complete comparison between each AT cannot be made. However, the three tested AT technologies enable me to consider exploratory ideas about each particular dimension. Listed below is a description of each AT being examined in this study. The description includes the predicted strengths and weaknesses of the AT based on my individual needs and the exact methods I used to type with the technology.

*Voice recognition software.* The Voice recognition software (VRS) I used in this study was Dragon Naturally Speaking 10 made by Nuance Technologies. Dragon Naturally Speaking was selected for two reasons. First, I was previously trained extensively with an earlier edition as a teenager and was familiar with the commands and set up. Second, it is one of the best and most reliable VRS software on the market. My workstation setup when using VRS consisted of me sitting up at my desk with my laptop at trunk level and AcousticMagic's desktop array microphone sitting behind the laptop approximately 36" away from me. Dragon provides and recommends users to use a headset microphone for better recognition. However, this is difficult for me because I require assistance from another person to take on and off the headset each time I access the computer. As a replacement, an array microphone enabled me to access and uses the software unassisted since the microphone only needed to be placed on the table to pick up my words. The array microphone was supposed to pick up clearly everything I said no matter where I was located within 8' in the room due to the five sensors placed in a long row, but I found the best recognition occurred when I stayed in approximately the same location each time I used VRS. A Predicted strength using Dragon is its ability to output text at a higher range (between 25-144 WPM) than most other AT. Another strength of the VRS is that the workstation enables me independently access the computer and software. There are three predicted weaknesses to

using VRS software. The first weakness is that I need to be located in a room by myself when I use the software. The software has a difficult time recognizing my dictation if there are significant amounts of background noise. In addition, my speaking into the microphone may interfere with other people that want a quiet working environment or if my environment must be silent. The second predicted weakness is the ability for the software to work efficiently between all of the computer applications I must use that requires inputting text. VRS computer application research focuses on typing in word processors and is the most efficient in those programs. Other computer programs such as a web browser, email, statistical programs, etc. may not be as compatible with Dragon due to less research put into smoothing out problems and/or updates the program may have that are not updated in the VRS. The third weakness to VRS is that its efficiency and use may be altered or impossible to do if my voice changes due to how alert I am or sickness.

*Head tracking.* The second AT selected for evaluation was head tracking. The head-tracking device used was Madentec's TrackerPro. It consisted of a wireless optical sensor and a reflective dot that had to be placed somewhere on my head each time it was used. Placing the dot on my head at first was a problem because it required assistance from another person. However, in the beginning of the study I realized the dot blended in with my glasses frame so I began placing the dot on the bridge of my glasses and kept it on for the week. This eliminated my need for third party assistance. I accessed the computer sitting upright at the computer screen and by moving my head for the sensor to track the location of the reflective dot, which moves the cursor on the screen in proportion to the head movement. One strength to head tracking is that I can use it independently in any environment without any interference. It is also compatible with any program that uses cursor movement. The head tracker can only produce

cursor movements (Man & Wong, 2007). A possible weakness to head tracking is that the typing speed seen in previous case studies of > 15 WPM (Man & Wong, 2007) is significantly lower than my current typing speed, which would lower my efficiency. Another weakness is that moving my head continuously and repetitively clicking with my thumbs may produce additionally repetitive motion injuries in the future after long-term use.

*Brain computer interface.* The third AT selected for evaluation was a brain computer interface (BCI). The BCI used was Brainfingers (Brain Actuated Technologies, Inc 2008). Brainfingers charts 11 different EOG, EEG, and EMG signal. Signals were obtained by three electrodes located on a headband placed on my forehead. The headband was connected to a black box that digitized and processed the signals into data that was transferred through a USB port connected to the computer. These signals could be linked to any cursor or keyboard action on the computer by making a signal reach an action potential. Once an action potential was met, the signal enabled either a continuous or a discrete function to occur. An example of a continuous function is the gradual directional changes of a cursor on a screen. A discrete function would be a single click to select with the cursor. Brainfingers/BCIs are a brand new type of AT that requires more research to make it more efficient for the public. A positive strength for BCIs is that for locked-in individuals who have no other way to communicate, the AT enables them to access the world. Strengths found in Brainfingers as a BCI are that it is non-invasive and that the training period to use the AT is relatively fast and simple (Brain Actuated Technologies, Inc 2008). Currently, Brainfingers has many weaknesses, but it is hopeful that with advances in technology, the weaknesses will diminish and the strengths will escalate. Current weaknesses for BCIs in general include slow typing speeds, 3<sup>rd</sup> party assistance for

setup, and training is required to use the signals. A weakness for Brainfingers specifically is that the headset is wired, which makes the user tethered to the computer at all times when using it.

Exploration of the three AT using the quantitative and qualitative data collected enables me to identify and rank in order of importance key aspects of an AT that I'd use for every day text input. Although AT was selected due to geographical convenience and not on AT that I'd realistically use as a whole, the key aspects identified were based upon minuet details discovered during actual use of each AT. Understanding and ranking specific details that are important to me in an AT is an additional method that helps improve my fit to an AT as a PWD.

As a member in the PWD community that use AT, the improved methods that helped me may also be helpful and improve the fitting of the general population of people with disabilities (PWD) to ATs. However, this additional method to selecting AT is based only on one single-person case study, which cannot yield definitive data about methods for a large general population. It is the goal of this single-person case study to begin to suggest potential methods to select AT for future research using multiple individuals and multiple types of disability constraints. Determining the success of the suggested potential methods requires additional research studies that include a thorough literature review and defined problem and solution spaces.

## **Methods**

### **Participant**

The participant is me, a 25 year old graduate student with a physical disability who is also the author of this thesis. My disability Arthrogryposis, limits my range of motion and function of most of my limbs and joints in my limbs.

### **Experimental design**

The study was a repeated measures design with three independent variables (IV):

1. The main IV, AT, three levels (VRS, Head tracking, and BCI).
2. A second IV, repetition, six levels, (1-6).
3. A third IV, task type, two levels (typing test, journaling).

The study had eight dependent variables (DV):

1. Set up time
2. Set up assistance needed
3. Total session time
4. Time for each task
5. Words per minute
6. Characters per minute
7. Number of AT Errors
8. Journal responses

In the task, the total session time was recorded. A session officially began the second I sat in the chair at the workstation or started manipulating with the AT for the day. The session ended when all work was saved and I stood up from the chair I sat in. The time it took to setup the AT and any third party assistance to setup or to finish the task was also recorded. In the typing and journaling tasks the characters per minute, word per minute, and number of errors were collected. Journal responses are included in Appendix A

The order in which the different AT was collected was controlled by counterbalancing the six sessions using the ABCCBA method. This method was repeated three times. I also completed additional journal responses that did not follow this method where any AT could be used that did not count toward any quantitative session due to the sporadic occurrence of an entry



and unknown duration of the entry. However, the information written was used in the qualitative data. Journal responses where only qualitative data was used are listed in appendix B.

## **Procedure**

The first part of the experiment consisted of typing sessions using the three different AT: VRS (correcting for errors), head tracker, and BCI. Each session consisted of the typing test, a break, and a journal response. The break length varied from 20 minutes-1 day. It was needed to prevent eyestrain. A maximum of two sessions were completed each day. The typing task duration was projected to last for 60 minutes, but sometimes was less due to malfunctioning AT and pain I had. The text used for transcription came from an accredited HF book. CPM and WPM using the Head tracker and Brainfingers was measured using Grass Soft Typing test, a free-ware program. In the VRS conditions, CPM and WPM were obtained by taking the total words/characters and dividing it by the duration of each test. The number of AT errors and typing errors was measured by using a tally application on an iPod Touch. The duration of setup, task, and total time was measured using a stopwatch application on the iPod Touch that ran simultaneously with the tally application.

The methods used for cursor control and text entry for the three ATs were different on multiple levels. Cursor control and text entry using Dragon Naturally Speaking was completed by saying different programmed commands to the computer or dictation using only my voice. I used the VRS by dictating my text and commands into the microphone. To correct errors, I would attempt to use only my voice using the correction dialog box unless it did not work after three tries. I then used my stylus to type the correct words into the correction box. All formatting was also completed by voice. Text input started in Microsoft Word, but due to

numerous translation errors, it had to be changed to DragonPad. DragonPad is Dragon Naturally Speaking's version of Window's WordPad.

Cursor control with the head-tracker was performed by moving my head in proportion to where the reflective dot is to the screen. To select items and numerous clicks, I used a peripheral device (mouse) by pressing it with my hands. Selections could also be completed using dwell clicking, however that is used when users have a difficult time pressing buttons. For text entry, I used the cursor to manipulate three different onscreen keyboards: Dasher, WiViK, and Hot Virtual keyboard. The first onscreen keyboard used was Dasher. Dasher is a third party predictive text entry system that is controlled through a zooming interface of a vertical list of characters (letters, numbers, and punctuation). There were many times Dasher froze and the data collected was lost or unable to be resumed, so a different onscreen keyboard replaced Dasher. WiViK was the next onscreen keyboard used. It is a keyboard identical to the QWERTY keyboard, except for an additional line of predictive text. In the middle of data collection, the trial period of WiViK ran out, and the full version that Office of Disability Services had would not install on the computer so I had to switch to another keyboard. The third and last keyboard used was Hot Virtual Keyboard, which was like WiViK, but without the predictive text. It also had a trial version, but the duration was much longer and the full application was significantly cheaper to buy.

Cursor control with Brainfingers<sup>TM</sup> was executed using two joysticks. The vertical moving joystick was divided into two sections and controlled by EMG signal. A section was triggered by tensing my jaw until the signal was in the right target. Upwards movements correlated with the top section and downwards movements correlated with the bottom section of the joystick. The horizontal joystick was divided into three sections and controlled by EOG

signal. Shifts in EOG signals to the right produced right horizontal movements, shifts to the left produced left horizontal movements, and stable signals allowed the cursor to remain stationary. Varieties of clicks of the mouse (left, right) were done by the EMG signal. To click, JB spiked the signal very quickly. To input text, I only used the EMG signal to control the cursor with the onscreen keyboard Dasher. To zoom through characters in Dasher, I proportionally controlled the cursor with the EMG signal using only a single vertical axis cursor. Vertical movements of the cursor were programmed to move proportionally vertically and horizontally around one set point. To begin and stop the zooming, I made a quick increase in the EMG signal, which caused the cursor to make a single selection click. Although I use Brainfingers using only muscle pathways (EMG & EOG) from the brain, which is not what within a BCIs definition. Brainfingers can still be viewed a BCI since it does have the ability to use non muscle brain pathways even though in this case I don't use it that particular way.

The journal responses were free write responses that discussed multiple topics related to disability, the use of AT, previous use of computers, and personal/social constraints related to AT. The journal allowed me to provide insight to the process from the user's perspective. Journals were completed using the same AT and methods that were used for the previous typing test. The duration of each response also varied between 20 minutes to one hour.

To evaluate changes in typing speeds over sessions, descriptive statistics of the maximum, minimum, mean, and median typing speeds for each individual AT was collected using the typing tests and journaling sessions.

The second part of the experiment compared the typing speed (WPM) of my traditional stylus typing on a tablet pc and VRS software. In both the VRS and stylus typing condition, errors were not corrected during typing. This decision was made because additional time was

needed to correct errors in experimental part 1 on top of the time that was used during transcription. The typing sessions in this experimental part were journal sessions and approximately one-hour long. Typing speeds were compared between VRS (no error corrections) and stylus typing using a one-way ANOVA. In addition, the maximum, minimum, mean, and median typing speeds for both VRS and stylus typing were compared. Journal responses for experimental part 2 are listed in appendix C.

## **Results**

The data were separated and analyzed into two different parts: quantitative and qualitative. The quantitative analysis had two different experimental parts. The first experimental part used the data from the original three assistive technologies (VRS, head tracker, and BCI) and all of the testing sessions (typing tests and journals). All assistive technology errors recognized during typing by the participant were corrected during the session. The second experimental part consisted of only journal entries using two assistive technologies: a stylus with a tablet pc and VRS. Assistive technology errors were not corrected in any of the entries, even if they were recognized while typing.

### **Quantitative Analysis**

**Experimental part 1.** The quantitative experimental part 1 dependent variables were based on typing performance and consisted of words per minute (WPM), assistive technology errors made (AT errors), and the frequency of AT errors compared to total number of words typed. The independent variables were type of assistive technology used (AT type) and the type of session completed (journal or test). The data from VRS and Brainfingers comes from the original setups of the systems. However, the data from head tracker comes from three different setups. Three different setups were needed due to the computer freezing and expired licenses of

onscreen keyboards. The first three sets of typing and journal sessions used the Dasher onscreen keyboard. The next two sets of data come from the WiViK keyboard and the last sets come from the virtual hot keyboard. Table 1 provides the performance variables means and standard deviations. The rationale to why all three setups were combined together will be made in the discussion section.

A univariate ANOVA was completed to test for any effects the three types of assistive technologies may have on each of the dependent variables: WPM, AT errors, and AT errors/total words. It also examined whether completing different test sessions (journaling or typing test session) significantly affected performance and whether an interaction between session type and AT type affects the performance of the AT. The univariate ANOVA was used because it was able to examine both the main effects for the two independent variables, AT type and session type, and the interaction between AT type and session type. See table 2 for the results of the univariate ANOVAs. Only one significant main effect was found. The WPM and AT errors performance in both the journal and typing test sessions was significantly affected by the type of assistive technology used. Tukey's HSD post hoc analysis was used to examine the specific order in which each AT performed within each dependent variable. The words per minute (WPM) in the journal and typing test sessions significantly varied between all three AT,  $F(2, 31) = 89.41, p < .01$ . WPM for VRS ( $M = 26.28$ ) was significantly higher than both head tracker ( $M = 8.93$ ) which was significantly higher than Brainfingers ( $M = 3.56$ ). This main effect does not come as a surprise since each AT is qualitatively different among each other in a variety of dimensions in the solution space. The analysis enables me to confirm the difference quantitatively. A more in depth analysis of the learning curve in typing performance using each AT was explored using additional descriptive statistics. See Figure 1 and Figure 2. For all three

AT, the minimum typing speed occurred during the first collection point. The maximum typing speed for both BF and HT AT occurred near the mid-end of data collection at sessions # 8(HT: 11.2WPM) and #9 (BF: 4.7 WPM). The maximum speed for VRS was during the last data collection point and was 33.8 WPM. The mean and median values were also analyzed for each AT. The mean for HT was 8.93 WPM and the median was 10 WPM. The mean for BF was 3.56 WPM and the median was 3.6 WPM. The mean for VRS was 26.28 WPM and the median was 26.9 WPM. See Figure 1 for the mean, median, maximum, and minimum for each AT.

The univariate ANOVA completed above also expressed that the number of errors (AT errors) made by each AT during each session, significantly varied among each of the AT types,  $F(2, 31) = 29.47, p < .01$ . The number of AT errors for VRS ( $M = 50.08$ ) was significantly higher than both head tracker ( $M = 19.75$ ) and Brainfingers ( $M = 7.85$ ). The number of AT errors for Head tracker ( $M = 19.75$ ) was higher than Brainfingers ( $M = 7.85$ ), but not significantly and significantly lower than VRS ( $M = 50.08$ ). The number of AT errors for Brainfingers ( $M = 7.85$ ) was significantly lower than VRS ( $M = 50.08$ ).

Although there was a significant difference seen in the number of AT errors using each AT type, these results do not take in consideration the discrepancy in the number of AT errors and the overall text length output among each AT. To balance this discrepancy, the probability of an AT error occurring dependent on the overall text length using each AT was formed by comparing the number of AT errors divided by the number of total words output. Using a univariate ANOVA, I found that there is not a significant difference in the probability of an AT error occurring among the different AT types,  $F(2, 31) = 1.27, p < .295$ . Although there is not a significant difference among each AT, an in depth analysis of each AT shows a learning curve trend in the probability of an AT error occurring. See Figure 3. Using BF the probability of an

AT error occurring per each word typed begins at 0.06, which is close to the mean of 0.052. Each session gradually decreases down to the minimum probability observed at 0.01364, which occurs during the ninth data collection session. After that session, the last sessions collected had an overall increase in probability. The maximum probability seen occurred during the last session at 0.12564. The median probability value for BF was at 0.045. Both the head tracker and VRS probability of an AT error's maximum value occurred during the first session of data collection at (HT: 0.09, VRS: 0.087). In addition both the head tracker and VRS's minimum probability of an AT error occurred during sessions #4 and #5, (HT: 0.02143, VRS: 0.01652). The probability for the rest of the sessions for HT and VRS increased slightly and leveled off close to the mean (HT: 0.05218, VRS: 0.03746) and median (HT: 0.04209 VRS: 0.03208) probabilities. See figure 4.

**Experimental part 2.** Experimental part 2 examines the typing speed (WPM) of my traditional typing method, and typing with VRS. The data from VRS comes from a new set of journal entries that were completed without any errors corrections. The stylus with tablet pc data was also from newly collected journal entries without any errors corrections. The data's dependent variable was words per minute (WPM) and the independent variable was type of assistive technology used (AT type).

A one way ANOVA was used to examine any differences in typing performance between typing with the stylus and tablet pc and typing with VRS. The typing performance was significantly different between the two different assistive technologies,  $F(1, 11) = 32.52, p < .01$ . See table 3. The WPM when typing with VRS ( $M = 39.45$ ) without correcting for errors was significantly faster than typing with a stylus and tablet pc ( $M = 19.44$ ). Similar to experimental part 1, a more in depth analysis of the learning curve using each AT was explored using

additional descriptive statistics. See figure 5. The VRS data collected from only the journal sessions in experimental part 1 where errors were corrected was included as a standard of comparison. In this section, the data was renamed VRS (corrections). In all three AT methods, the minimum typing speed occurred in the second journal session (VRS no corrections: 26.9 WPM, Stylus: 15 WPM, and VRS corrections: 14.9 WPM). See figure 6. The maximum typing performance for both corrected and uncorrected VRS was during the last data collection point (VRS no corrections: 50.9 WPM and VRS corrections: 33.5 WPM). The maximum typing speed for stylus was 22.2 WPM. The mean and median was also examined for each AT. The mean for VRS no corrections was 39.45 WPM and the median was 39.25 WPM. The mean for VRS (corrections) was 25.54 WPM and the median was 24.46 WPM. The mean for stylus was 19.43 WPM and the median was 19.36 WPM.

### **Qualitative Analysis.**

The qualitative data comes from the content in the journal entries sessions. In addition to the journal entry sessions used in both parts of the quantitative analysis, an additional ten entries were included. These ten entries were not included in the quantitative session because they occurred randomly and were completed using the closest available AT at the time. The majority of the time the AT used was my tablet pc and stylus or VRS. Time and errors also were not recorded. The qualitative analysis was developed by finding specific themes in the journal entries. Each frustration theme consisted of 1) a problem that related to the use of AT that was discussed in the journal responses, 2) were written frequently in the journal responses, 3) had a ranked level of frustration associated with it, and 4) a ranked order of the most likely to least likely AT that could alleviate the frustration. The frustration level ranking was based on a scale from 1-10 with 1 being the least frustrating and 10 being the most frustrating. The ranking was



completed subjectively. A subjective ranking is valuable in this type of analysis because it shows how I, the user, truly feel about my experience. Levels 1-3 of frustration caused me to be irritated at the AT but still enabled me to use the AT without significantly affecting my performance level. Levels 4-7 of frustration caused me to have slight bursts of anger where I had to stop working routinely and take a break to calm me down. After the break, I would still be able to work efficiently. Levels 8-10 of frustration caused me to be extremely irritated and angry. I would have frequent urges to quit working and never continue even after a break. However, I always continued working after a break, but my performance level was slower. The ranked order of the likelihood each AT's success at alleviating my frustration included the AT only used in the first part of the methods. In addition, the ranking also described why each AT was ranked in that order. The seven themes were 1) independence, 2) output speed relative to cognitive speed, 3) reliability of AT, 4) personalization, 5) internal negative emotions and thoughts, 6) physical and mental discomfort, and 7) cursor control.

**Independence frustration.** The independence frustration explored the overall general lack of independence that I had using an AT and two specific areas. The two specific areas where my independence was lower than my expectations were in workstation/equipment maintenance and technical equipment/software maintenance support. Workstation/equipment maintenance frustrations were caused by all the unexpected physical assistance needed with each AT's workstation and equipment due to physical displacement after the initial setup. Technical equipment/software maintenance support frustrations consisted of the overall process it took to receive help, which included the number of support options available, the time availability of the support, and the duration it took to have a problem resolved. Lack of independence occurred frequently in journal entries and caused the highest level of frustration. The best AT solution for

a general lack of independence was VRS. I completed all the VRS sessions independently and at any time I had the will to use it. Except for the initial setup of the equipment where I received help getting the microphone out of the tightly packed storage box, I was able to make all physical adjustments and alterations independently. I solved most of my VRS software problems using known knowledge about computers and Dragon Naturally Speaking. If I did not know the solution, I was able to search using a Google search or ask experts on online message boards. The second AT solution for solving my independence frustration was using the head tracker. I was capable of completing the head tracker sessions with a medium level of independence. Once a week, I was dependent on receiving assistance from others to put the infrared dot on my glasses. However, the rest of the week I was capable of accessing and using the head tracker fully independently if the tracker camera stayed in the position I left it. I required assistance adjusting the tracker if my lab mates took it down or moved it while they used the computer I used. I was unable to independently solve my technical problems due to the numerous options and software programs available to use with the head tracker. For technical support I had to go to my university's Office of Disability Services. I became frustrated receiving support due to the length of time it took to receive the software I needed and replies to my questions. Sometimes it took a full week to receive assistance. Once I received help, the software I received was out of date and not compatible with the computer I used. These difficulties slowed down my progress, which was very frustrating. The least likely AT to solve my independence frustration was a BCI. First, I needed assistance placing the headband on my head every time I used the system. The actual receiving of assistance did not frustrate me, but organizing and scheduling around multiple people's schedules was frustrating. Developing schedules that worked for my assistants and I was time consuming and decreased my work productivity. It was frustrating that I was unable to

work at the times or duration I preferred. Receiving technical support was an area I was independent with the BCI. If I had any problems, I was able to directly contact the inventor of the BCI used, Brainfingers. I also communicated with two of my lab mates who were experts of the system.

**Low output and cognitive speed ratio frustration.** The low output and cognitive speed ratio frustration held occurred the text output on the screen using an AT was different from the speed of the cognitions in my mind that I wanted to express. This caused me to forget many of my important ideas and slowed down my performance. I had a high level of frustration throughout the whole study. The ranking of AT as a solution for the low output and cognitive speed ratio frustration was VRS, head tracker, and BCI. It occurred at a high frequency using the BCI, medium frequency using the head tracker, and low frequency using VRS. This ranking of the AT is the same order as the ranking of the highest to lowest typing speed of each AT found in the quantitative analysis. This similarity was not predicted, but is conceptually accepted due to the frustration's ratio was directly impacted by output speed.

**Reliability frustration.** The reliability of the AT frustration happened when a high frequency of random unexpected errors without any alternative solutions to fix occurred or when the errors caused the AT to be unusable. The reliability of an AT became a medium high frustration. VRS had the highest reliability out of all three AT and was the best solution. When errors would occur, I quickly found efficient alternative solutions. Both the BCI and the head tracker had lower levels of reliability, which sometimes required me to stop all work with each AT for the day. Stopping all work due to reliability issues occurred more with the head tracker than the BCI. Sometimes work was stopped for a few consecutive days using the head tracker

because I had to wait for technical support. When unexpected errors occurred using the BCI, I was able to receive assistance within a few hours or the next day.

**Personalization frustration.** The lack of personalization options frustration occurred only when I searched for an onscreen keyboard program to use with the head tracker. I wanted to have a keyboard layout that consisted more than the basic QWERTY layouts with only standard keys. I had a relatively low level of frustration associated with it. Since, this frustration only occurred using the head tracker, there was not a specific AT solution. However, I did have to use different onscreen keyboard programs due to technical difficulties, which enabled me to compare the personalization options of each program. The best on screen keyboard for personalization options available was the hot virtual keyboard. This keyboard had the standard keys and multimedia keys that I could use in multiple programs.

**Internal negative emotions and thoughts frustration.** The internal negative emotions and thoughts frustration was internal and consisted of resistance toward using any computer and AT. I had a difficult time being receptive to any AT due to the bad experiences I had as a child. None of the AT's could solve this problem. The best solution was slowly realized throughout the study that I had to accept the need to change my attitude and attempt to change it.

**Physical and mental discomfort frustration.** The physical and mental discomfort frustration was due to all of the headaches or other body pains I had using all of the AT. Physical and mental discomfort had a low level of frustration associated with it. The best AT solution for physical and mental discomfort was using the VRS. I rarely had any body aches or headaches while using VRS. The head tracker caused slightly more pain when I used it due to repetitive eye and neck strain. The most discomfort occurred using the BCI. I developed

headaches on a regular basis using the BCI. Most often, the headaches were numbing and dull which I perceived as just annoying. Rarely the headaches caused immense pain.

**Cursor control frustration.** The cursor control frustration was apparent when the process it took to move on the desktop and make selections was tedious, difficult, or felt too slow. I had a low level of frustration associated with it. Cursor control is a necessary repetitive task completed on computers, so I needed an AT that was efficient at that activity. The head tracker was the best AT to do all cursor control. The HT's cursor moved fluid with my head movements and selections were easy to do with my thumbs pressing the necessary buttons. Cursor control using VRS was a high cognition process because I had to remember the exact commands needed for each action I wanted to complete or I had to go through a process using a numbered mouse grid to make selections. Moving the cursor using BCI was difficult because each movement required a very minute change in a Brainfinger channel signal. I often would produce either too little or too much of a channel change, which caused the cursor to move around the object I wanted to select and never on the object.

In the discussion section, the implications of both the quantitative and qualitative results for the current case study were explored. The implications included how the quantitative performance specifically influenced the decision to use each AT and the frustrations found in the qualitative section as they related to each AT were discussed in detail. In addition, the decisions behind the AT selections in the case study were examined as possible key determinants necessary for selecting the correct AT for the general population of people with physical disabilities.

## **Discussion**

The present self-study examined the quantitative and qualitative performance of three assistive technologies for me, a person with a physical disability, in my home office. There were three purposes for this study: 1) find a new AT that I can use that alleviates my repetitive motion injury, and enables me to create extensive documents efficiently type, 2) determine specific characteristics of an AT that are necessary or preferred when I select a new AT for myself, 3) formulate and recommend future research for improving methods to select AT for the general population of PWD based on the implications found in my exploration and search for a new AT.

### **Goal 1: Find a new AT to use for myself**

This study did not look extensively at all of the possible AT available to me as a PWD with limited arm movement, so a definite selection of a new AT for me to transfer to cannot be made. However, of the three AT examined, I can determine that even if the additional AT not used in this study are examined, there is a high probability that the AT I end up selecting will be a hybrid of different ATs. Each AT was able to complete certain computer tasks extremely well and other tasks not as well. Of the three AT currently examined all of them could complete all the tasks, but from the results it was clear which AT worked best for certain tasks. For general computer use of typing and cursor control, VRS was the best AT to use for typing and HT was the best AT for cursor control. BCI performed the worst in both typing and in cursor control. Given these results, a possible hybrid of AT that should be examined in the future are VRS and the HT. Eye gaze interaction is another AT that should be examined individually and in a hybrid with VRS as possible AT solutions in future research. The determination of the best AT for specific tasks and possibly future hybrid ATs came from the examination of quantitative and qualitative details. The examination of quantitative and qualitative details of the three AT was also the second goal of the thesis.

## **Goal 2: AT preferences based on quantitative and qualitative analysis of each AT**

**VRS.** VRS was the most preferred AT to use for typing.

*Quantitative Analysis of VRS.* Based on the quantitative analysis of the first part of the experiment, VRS with errors corrections had the fastest typing speed (~28 WPM) out of all three AT. All of the AT errors were corrected during the session. It also had the highest AT errors per session (~ 25/session). However, when the number of AT errors was compared to the overall number of words output, VRS had the least frequent AT errors per words out of all three ATs. A common error was when the words I said appeared in the green dialog box correctly, but would not actually be present or presented correctly in the program. Another common error that occurred was that the software would type words that sounded similar to phonetically to what I spoke and not the actual words I meant. Although I attempted to correct all errors, I found additional errors after the session was completed. I never corrected these, but acknowledged them as instances that I would have to take additional time later in my typing process.

Although the frequency of AT errors per total words typed was the lowest using VRS, it took incredible amounts of time to fix the errors that did occur. This caused me to stop frequently in mid-thought, which made it difficult to remember the next thoughts I needed to type. In an attempt to alleviate this problem, I completed journal entries using VRS without correcting for AT errors during dictation in the second part of the study. In addition, as a standard for comparison, I completed journal entries with my traditional stylus typing and did not correct for errors during production. The results showed that typing with VRS without correcting for errors was significantly higher than typing with VRS while correcting for errors and typing with stylus. This increase in typing speed with VRS not correcting for errors during text production provided me a better and more efficient way of expressing the necessary output

because it kept up with my cognitive speed of thoughts. Keeping up with my cognitive speed was one of the many important factors I found in the qualitative analysis.

***Qualitative analysis of VRS.*** The qualitative analysis of frustrations I had using AT supported VRS as a viable AT for me to use in the future. Four out of the seven frustrations found in the journal entries suggested the use of VRS as a possible AT solution. In addition, 3 of those frustrations solved by using VRS were the top three frustrations that had the highest level of frustration and were the most important to solve. The four frustrations that suggest VRS as an AT solution are independence, low output and cognitive speed ratio, reliability, and physical and mental discomfort.

The independence frustration had the highest level of frustration and most frequently mentioned in the journal entries. VRS was the best fit for the independence frustration because I was capable of using the workstation at all times of the day without assistance from another person to set up the workstation. In addition, I was capable of maintaining and fixing any changes in the VRS workstation design, equipment, and program by myself and continue working. Some changes in the VRS workstations that I discovered included when a Personal Assistant would move or unplug the microphone when cleaning the workstation or the microphone would randomly stop working in the input jack of the computer. Also, the VRS program would periodically stop working efficiently which slowed down response time and decreased accuracy. Sometimes fixing the VRS workstation problems was physically challenging for me due to the microphone being so large and physically distant from my body's reach, but different low tech adapted household tools allowed me to work past the challenges. When the VRS program performed with less efficiency, I searched for answers online from other users and combined their answers with my current basic computer knowledge.



The low output and cognitive speed ratio frustration consisted of the output speed of text using an AT to be much slower than my cognitive speed of forming thoughts and ideas. This caused me the second strongest frustration because I tended to forget important ideas and their specific details that were in my head due to the large time gap between when I had the initial idea and when the idea was actually typed out on the screen. This frustration rarely occurred when using VRS, which is why it is the best AT to solve this frustration. In experimental part 1, I believed that the VRS kept up with my cognitive speed relatively well and did not think it could do much better in the second part. However, I was pleasantly surprised when the WPM for VRS in the second part was almost double the first part of the experiment's speed and higher than my typical stylus typing speed. I never realized before that the stylus typing was slowing me down by such a large amount.

The AT reliability frustration was my third largest frustration. An unreliable AT was one that's performance was inconsistent most of the time I used it. The inconsistency and unreliability was a problem because I never knew approximately how much typing I could actually complete and save for each session. Knowing a consistent performance rate is vital for my work in the future as a professional in order to plan my time to make important deadlines such as grant proposals. Lack of reliability using VRS was a small problem, especially compared to the other AT. At times, VRS would not recognize my voice and did not type the correct words or perform the correct commands, which slowed me down. However, these inconsistencies were fixable and easy to overlook once I became patient with the system and the word processor DragonPad. I learned quickly to avoid some of the inconsistencies using VRS by searching for alternative ways to dictate words and commands on the internet. Dragon Naturally Speaking was less reliable when I used other applications besides Dragon Pad to type. In other

programs, my words were recognized less. In addition, the applications JB used did not always execute the VRS commands even when Dragon Naturally Speaking did recognize the commands and said they were executed.

The physical and mental discomfort frustration had a relative low level of frustration associated with it. Body and headaches would occur using the AT, which was a nuisance while typing. Physical and mental discomfort rarely happened when using VRS and if it did, it never stopped JB from completing a session unlike the other AT.

VRS was not the solution for solving three of the frustrations found in the qualitative analysis: cursor control, personalization, and internal negative emotions and thoughts. The cursor control frustration using VRS was moderately high and made me not want to use VRS for it unless it was the only option available. I used the cursor by using mouse grids and by dictating different commands, but both ways were cumbersome and tedious. The personalization frustration consisted of options that I wished was available to me that would make an AT fit my specific needs and wants. It overall did not cause a lot of frustration or occur frequently, but was something I would have liked to have available to me. An area that VRS had a personalization option was the ability to set specific verbal personal commands in a program. I did not make use of this option because I was comfortable using the default settings for typing. I was comfortable with the default settings because of the extensive previous experience I had using VRS as a teenager. One aspect of VRS that I wanted personalization options was in using cursor control. I am unsure what the options would be, but the current cursor options available are not something I would use.

The internal negative emotions and thoughts frustration originated from my negative emotions, thoughts, and resistance towards any AT. I had mixed feelings towards AT due to

experiences in the past where I was given AT that never worked as well as I expected. I knew that I needed to be receptive to using a new AT for my physical health, but I still did not want to change. I had to get past these thoughts and feelings to use all of the different AT, especially VRS. VRS was the most difficult AT to work past this frustration because of my previous experience using it did not go well. When I was first trained to use VRS as a teenager, it was a very old version of Dragon that was extremely unreliable. In addition, back then I was resistant to use the technology because I did not cognitively understand how important it could be for me in the future. I also had negative perceptions of VRS because the training sessions made me miss class. As a student who took my studies seriously, I hated missing class, especially if the reason for missing related to my disability. To me, my disability was not supposed to interfere with my education and I was determined to do everything to not let it interfere.

**HT.** The HT became the second preferred AT for typing and the most preferred AT for cursor control.

***Quantitative Analysis.*** Based on the quantitative analysis of the first part of the experiment, the head tracker was partially supported as an assistive technology for me to use in my home office. As a typing AT device the head tracker's mean typing speed of 8.87 WPM was too slow compared to the VRS system, but much faster than a BCI. A positive aspect to the head tracker while typing was that there were fewer errors made than with the VRS system. However, despite the decrease in the amount of errors made by the head tracker, it was not an acceptable system for JB to transfer to for typing. The head tracker as a typing device lowered JB's overall performance and in real life applications would not be able to keep up with my needs. The frequency of AT errors per total words typed initially was high, decreased, an increased spike, and then dropped into a consistent low ratio. Typing performance using the head tracker had

variability due to switching the onscreen keyboard three different times. Frequent program crashes and program incompatibilities caused the changes in keyboards. The keyboards used were Dasher, WiViK, and Hot virtual keyboard. The data for the three setups were combined together was made taking into account whether the difference in typing speeds would affect my productivity in real life applications. When examining all of the typing speeds using each keyboard a trend develops. Initially with Dasher, the typing speed progressively gets faster with the highest speed reaching 10.5 WPM. The AT errors per total words started at 9 AT error for every 100 words typed and the lowest AT errors seen per total words was 1 AT error for every 50 words typed. I stopped using Dasher because it repetitively crashed in the middle of my typing sessions and I lost all of my data. WiViK was only used for one session due to the trial period ran out of time due to my assumed belief that the university had a copy of the full program available and compatible with the any lab computers that I could install after the trial period ended. The mean typing speed for the one session was 8.8 WPM, which was higher than the average typing speed using Dasher, but lower than the lowest typing speed using the hot virtual keyboard. In addition, for every 100 words typed, there was an estimated 7 AT errors. There was a possibility that if I continued to use WiViK, the typing speed would have changed, but currently it is unknown whether it would have changed. The last keyboard used, the hot virtual keyboard's typing speed started out relatively high at 10.4 WPM and stayed close to that speed throughout the rest of the sessions with some variability. An average of 3-4 AT errors occurred for every 100 words typed. Although there were fluctuations in performances using each keyboard, the head tracker still had a relatively low typing performance.

***Qualitative Analysis.*** Based on the qualitative analysis, the head tracker had the best cursor control and personalization options, but was not a supportive AT to use to solve the other

five frustrations I had. I did not have any cursor control frustration using the head tracker. I was capable of moving the cursor and make selections with fluidity and ease. It was extremely easy for me to do all actions because it required the same techniques used to select keys to type on the onscreen keyboard. The frustration caused by the need and want for aesthetical, functional, and personal preferences was inexistent once I used the hot virtual keyboard. The Hot Virtual Keyboard had multiple keyboard layouts that enabled me to personalize all of the functions I needed to type on the computer. Each of the preprogrammed keyboard layouts had options where I could add or delete keys on that layout specific to my preference. The layout I chose was “tight2” which had cut, copy, paste, home, end keys. I also liked the option to have an auto-repeat key function. The auto-repeat function enabled a key on the keyboard to be repeated continuously as long as the key was pressed and held. This feature was useful for me because it decreased the number of key presses.

The slow output speed to cognitive speed ratio frustration, physical and mental fatigue frustration, internal negative thoughts and emotions frustration, and independence frustration did not support the head tracker as an AT and caused a low to moderate level of frustration when I used it. I viewed the output speed to cognitive speed ratio to be too slow and I thought it hindered my overall typing performance. The slower output speed caused me to forget content topics and specific details to topics. I had a difficult time forming content to type, so when already formed content was forgotten, I was irritated and did not want to continue working. The output speed was appeared to me to be only  $\frac{1}{4}$  slower than cognitive speed, which was helpful because only some content was forgotten. This made the head tracker functional but not ideal to use as a converted AT. The physical and mental fatigue occurred at random times while using the head tracker. I usually developed headaches usually when I started a session already

mentally fatigued from the first part of my day. Physical fatigue occurred in my thumbs from the repetitive motion of clicking the mouse. This also only happened when I strained my hands in other activities previously during the day. The physical fatigue could have been a warning sign for a repetitive motion injury in development. The internal negative thoughts and emotions frustration occurred in general at a very low level every time I used an AT. Negative thoughts and emotions were caused by my resistance to use anything new and different and nothing specifically was due to the head tracker.

The independence frustration moderately frustrated me when using it with the head tracker. I was able to use the head tracker independently 80% of the time. I had access to the system anytime in the day and every day of the week. However, I lacked independence setting up the head tracker workstation. During setup, I needed assistance placing the reflection dot on/off my glasses. In the middle of data collection, I discovered a way to be more independent by having a PA put the reflective dot on my glasses on Monday morning and leave it on until Friday afternoon. This solution worked the majority of the time, but failed if the dot came off randomly during the week.

Other aspects of the independence frustration that was important for selecting an AT were the ability to repair hardware and software and access to technical support. Since the workstation was located in a lab, often the workstation was physically changed. Other users would change the height of chairs, desk, and move the head tracker out of my reach. When this happened, I was unable to reposition the equipment and had to wait for assistance. Sometimes assistance was unavailable, so I was unable to work that day. I also became frustrated while I transitioned between all of the keyboards. I became frustrated because I knew the exact problem in the first two keyboards, but had to wait for extended periods for experts to fix it or provide me

with new software. I was unable to continue the rest of my work while I waited. Being forced to put work on hold for periods of time would be unacceptable for me now and in the future as a professional.

The reliability frustration caused me the highest level of frustration with the head tracker. The head tracker was unreliable only in typing tasks with the onscreen keyboards. I was unable to use the AT at times due to random errors and demo trial periods ending. I could not fix independently these reliability issues, which inhibited me from completing any work. The first on screen keyboard, Dasher crashed multiple times at higher typing speeds, which caused me to lose all of my data. The first time it crashed, I repeated my session, but during the repeated session, Dasher crashed another two times, so I gave up and quit. In addition, random errors appeared that caused me to reload the software. I searched for software updates and patches on the developer's website, but no new updates were found at that time. I also had difficulties with the second keyboard, WiViK that I selected due to being unable to receive a working full version of the program after the trial version ran out of days. I was frustrated for three reasons. First, without any working copy of WiViK, I was unable to continue with my work. Secondly, it took time to locate, contact, and arrange a time to meet the AT specialist at my school's Office of Disability Services that was available for both parties involved. Once I finally received the copy of WiViK, I had to search for an external floppy drive in order to install it on the computer since newer computer models do not use floppy drives. Third, once I attempted to install WiViK I found out the university's version I received was too outdated for all the computers available.

**BCI.** The BCI Brainfingers was the least likely AT that I would choose for both typing and for cursor control. Both the quantitative and qualitative analyses support this decision.

***Quantitative analysis.*** Based on the quantitative analysis, Brainfingers had the slowest typing speed overall. It began at 1.8 WPM, increased to 4.7 WPM in the ninth session, dipped down in speed, and ended with the last session being at 4.1 WPM. The number of AT errors Brainfingers made during the initial session was approximately 3 out of every 50 words typed. The number of AT errors then decreased in a staggered pattern up to the ninth session. In the ninth session, only 1 AT error occurred for every 100 words typed. After, this session, the AT errors increased in a staggered pattern to a peak in the last session of 13 AT errors for every 100 words typed. The overall pattern for AT errors per words typed was highest using Brainfingers in comparison to VRS and HT. Due to the slow typing speed and high frequency of AT errors per total words typed, Brainfingers is unfit as an AT for me to use in my home office.

***Qualitative Analysis.*** The qualitative analysis demonstrates that Brainfingers supported only the personalization frustration as a possible solution to the seven frustrations. I was able to configure any specific Brainfingers channel to my specific needs. In addition, I was able to have all of the necessary settings in Dasher to fit my needs.

The physical and mental fatigue frustration, reliability frustration, and internal negative thoughts and emotions occurred at low levels for me using Brainfingers. In the physical and mental fatigue frustration, I developed headaches from having the headband too tight or became fatigued after using the system for long durations. Sometimes the headaches were so bad I had to quit a session and restart the next day. The reliability frustration using Brainfingers was a problem at the beginning of each session I completed. At times, when I attempted to start a new session, Brainfingers would not always respond or it would not complete a task correctly even though both the previous and new session settings were the same. To correct this problem, I revised my settings through trial and error processes. The trial and error process was relatively



quick and simple, but time consuming. When reliability issues occurred with Brainfingers, I corrected the problem by finding alternative solutions or communicating with the developer of the Brainfingers hardware and software. The internal negative thoughts and emotions frustration occurred infrequently and happened using Brainfingers with the same frequency as any of the other AT.

Three frustrations where Brainfingers caused me a moderate to high level of frustration were in the cursor control frustration, independence frustration, and cognitive speed to output speed ratio. Cursor control using Brainfingers was a tedious process that took extra cognitive resources to complete it. I had to concentrate each time I completed any cursor control task and often it took multiple tries in order to get it done. When I tried selecting an item, I often surrounded the item but never was on top of it due to difficulties controlling minuet changes in the Brainfinger channel. In the independence frustration, I had the least independence using Brainfingers compared to the rest of the ATs in this study. I was unable to setup Brainfingers, which required me to have another person help me each time I used Brainfingers. This caused difficulty for me because I could only work when someone was available or schedule ahead of time when I worked. In the output speed of text relative to cognitive speed ratio frustration, my cognition was too fast compared to my output of text. I often forgot important content and new ideas while I waited for my output to appear on the screen. This made typing very difficult for me and was unacceptable for a future system.

**Summary of important dimensions in the solution space.** The overall analysis of each AT enabled me to conclude that the best dimensions provided me with the most productivity and efficiency using the AT, which is similar to results from previous studies that examined factors that kept users with a disability to continually use his or her AT (Koester, 2004; Lenker, Scherer,

Fuhrer, Jutai, and DeRuyter, 2005; Johnston and Evans, 2005; DeRosier and Farber, 2005; Rigby, Ryan, From, Walczak and Jutai, 1996). I discovered that dimensions that specifically demonstrated productivity and efficiency were typing productivity, methodology used to manipulate cursor, methodology used to manipulate the keyboard, independence, and reliability of AT. I preferred AT that had a high typing speed, low # of AT errors, and used traditional point and click methods for cursor control. If an onscreen keyboard was used, I liked a traditional point and click QWERTY onscreen keyboard that had auto repeat of keys when a key is selected and held for a short duration. Two dimensions that were not defined in the original solution space, but became important in my end selection was the ability to use the AT independently and reliably. Studies by Koester (2004) and DeRosier and Farber (2005), support my findings. They saw that participants who continued use of their AT and liked using it said that the reason why they preferred that particular AT was because it enabled them access to the computer independently and increase their typing speed, which would not be capable using other AT. Additional support by Lenker, Scherer, Fuhrer, Jutai, and DeRuyter (2005) demonstrates that in addition to typing and cursor efficiency, participants maintained and liked their AT if it was dependable, physically comfortable, and did not require substantial physical and cognitive effort to use. Johnston and Evans (2005) also discuss that although each dimension is equally important in selecting an AT, often one AT cannot satisfy all of the user's needs. To alleviate this problem the user has to rank the importance of each dimension and select a combination of AT that provides the highest ranked dimensions to the user.

**Conclusions to self-study.** Based on the findings from this study, I have gained insight into important features to me for a new AT and workstation for my home office. I now know that from the current AT examined a hybrid of AT will be best for me. The best typing AT

currently is VRS and the best cursor control is using a head tracker. It is unknown whether these AT are the final best AT for me to select since other possible AT solutions still need to be examined. Once the other AT solutions are examined in a home office environment and a final choice in AT are made, I then must begin the process of acquiring and setting up the AT for my personal home office.

### **Goal 3: Future implications for improving AT selection methods for the general population of PWD**

**General Population Implications.** The quantitative and qualitative results from my present self-study provide implications for fitting a general population of persons with disabilities to assistive technologies. The specific requirements for each individual in the population will often vary, but the overall purpose of independent efficient access to a computer is the same for all individuals. My quantitative results demonstrated that typing speed was the most important factor in selecting a computer AT for a PWD. The typing speed in this study included the time it took to correct AT errors. A user may have the ability to functionally use a variety of AT, but when choosing AT specific to their needs, the typing speed should be greater than or equal to the speed of the user's current typing methods. An equivalent or higher typing speed provides the user with a smoother transition to an AT since, productivity would not be negatively affected.

My quantitative results demonstrated that when comparing different AT, the frequency of AT errors and the time it takes to correct the errors do not necessarily inhibit the AT from being a viable choice for the PWD to use. Having to correct AT errors does decrease the typing speed. However when selecting an AT, what is more important is that the AT that is chosen has the best typing speed productivity relative to cognitive production speed.

My qualitative results in my self-study demonstrated that the AT selected for a user should cause the least levels and amount of frustration when using it. Characteristics of AT with low levels of frustration would be ones that provide the user the most independence, reliability, and whose output speed was relatively equivalent to the user's cognitive speed. The AT selected should enable the user to physically access, setup, and use the AT independently. The user should be able to predict the performance rate of the AT and rarely expect AT errors each time it is used. If errors or other problems do occur with the software and hardware, the users should have readily accessible methods to solve the problem independently or the ability to communicate with experts of the AT that will help them in a timely manner.

#### **Implications on Ideal Users for Each AT.**

**VRS.** An ideal user for a VRS would be one who has full control of their speech. Their speech does not have to be perfect, but vocal idiosyncrasies should be persistent. The user should also have the cognitive ability to remember the different commands needed to complete tasks or fix errors. The user also should have some vision. Users with disabilities that choose this technology are likely to have at the least limited arm and hand function that inhibit their ability to use a traditional keyboard and mouse. Users would only be able to use this AT in quiet environment where they are not disturbed or disturb others.

**Head tracker.** An ideal user for a head tracker would be one who has full control and movement of one's head or a body part that moves in similar ways. Unlike the user, in this case study that used the head tracker just for cursor navigation and a switch device for cursor selections with another body part, the traditional head tracker user performs cursor navigation and selections using just one chosen body part. The setup of cursor control and the user's body depends on the user's specific physical abilities. Head tracker users are likely to have limited

functionality of their arms and hands. The head tracker is also a suitable option for a person who has limited speech control in addition to their limitations in limb functionality.

**BF.** BCIs current technology abilities are only capable of completing computer/typing tasks at relatively slow speeds compared to the other technologies in this study. However, BF technology can exhibit higher typing speeds compared to other current BCIs such as p300.

Typing speeds using EEG imagined motor tasks and the Hex-O-Spell text entry system average to be 7 CPM while this study using EMG had an average of 14.7 CPM (Krepki et al 2007).

Although the typing speeds exhibited in this study used only the muscle channel and not the EEG channels, what is important to remember is that typing was proficiently accomplished using the system. For locked-in individuals who are unable to use other alternative AT to communicate and to access a computer, any level of independent communication is worthwhile. It is hopeful that as BF and other BCIs evolve the technology will become more practical and usable for all individuals no matter what the ability type.

**Future Research for Myself.** The methodology from this present self-study can now be used as a guide for exploring AT in future research for me. In this study, a combination of ATs and workstations were formed that at the current time that fit my professional and personal needs as a graduate student and future professional in a home office environment. This home office environment's workstation was placed in a fixed quiet location and was where the majority of my workload is completed. However, in the future, a portion of my work must be completed in mobile environments including environments with higher levels of noise and locations shared by a group of people, which will cause me to find a new alternative mobile workstation. Similar to finding a workstation for a home office environment, finding a mobile workstation also should be approached using dynamic systems theory. I would still have many of the same dimensions

and constraints that guide me to choosing a workstation as I did for a home office environment, but the added dimension of mobility provides additional constraints that must be taken into consideration. A challenge in choosing a mobile workstation I have is finding one that causes me the least frustrations and is within my physical abilities. Specifically, the problem I have is finding a workstation that I can manipulate (setup, carry, and tear down) independently with relative efficiency. In the current study, I realized this problem would occur in a mobile workstation and brainstormed possible ideas and solutions in many of my journal entries. One idea I had included having a device similar to the Ipad that I would use with my hands to take short notes in meetings and class lectures. Another idea was to have a laptop or high end tablet device that could be used as a desktop replacement and was capable of completing long documents and presentations. Further research was needed to test these two workstation ideas and to examine other possibilities.

**Future Research for General Population.** Implications for future research on selecting AT for the general population of PWD were discovered in the results of this study. One area that could be examined in future studies is the role learned helplessness may play in PWD accepting AT. I found that one of my ongoing frustrations throughout this study was the struggle I had with my internal negative emotions and thoughts toward any AT. I knew logically that I needed a new AT, but mentally and emotionally I loathed the idea of using any AT. These negative emotions and thoughts made it difficult for me to motivate myself to use any type of AT. I believe that one reason I had such negative affect toward AT was due to being given a variety of AT through the years that never fit my exact needs or expectations. This frustration from never having the right AT work for me developed into a negative attitude and a hesitance to use all AT introduced to me. The development of my negative attitude can be explained by Seligman's

theory on learned helplessness. Learned helplessness is a behavioral response that develops in subjects who are placed in uncontrollable, inescapable, and aversive stimuli. These subjects are incapable to escape the stimuli and when they are given the opportunity to escape the stimuli they remain helpless (Seligman, 1975; Cole, 2007; Padilla, 2009). The theory originated in animal studies and through the years has been seen in humans. In these studies, approximately one third of the subjects given the aversive stimuli condition develops learned helplessness. Both humans and animals who exhibit this behavior are prone to become depressed due to stress and have a more difficult time coming out of the depression (Seligman, 1975; Willner, 1984, 1991; Weiss, 1968). Current research explains that the 1/3 of the subjects that develop learned helplessness is possibly due to their attribution style for positive and negative events. Subjects who attribute negative events to internal, stable, and global causes were more likely to develop learned helplessness, have a difficult time recovering from depression, and relapsed more often in a situation than subjects who attribute positive events to internal, stable, and global causes (Edelman, Ahrens, & Haaga, 1994; Ilardi, Craighead, & Evans, 1997; Johnson, Crofton, & Feinstein, 1996; Johnson, Han, Douglas, Johannet, & Russell, 1998; Needles & Abramson, 1990; Voelz, Haeffel, Joiner, & Wagner, 2003). The development of learned helplessness in depression, recovery, and relapse can be paralleled to acceptance of AT by PWD. It could be speculated that if the PWD has developed learned helplessness with AT, then it may be more difficult for the person to attempt to try and use new AT presented to them.

A second area that should be examined in future studies that assess the selection of AT for PWD is the methodology used to select, introduce, and train AT that is in cohesion with the individual's developmental life stages. It is common in this information age for people of all ages to use on a regular basis computer technology. This means that AT needs to be introduced

at every age range and developmental stage. To successfully introduce AT at every developmental stage, it is critical to understand an individual's life stage and development because it provides insight to how the individual views and interacts with their environment (Kail 2006). A life stage is a specific set of physical, mental, and emotional characteristics that an individual possesses at one time during his or her development. The developmental stage of an individual only has an approximate relationship to his or her biological age (Kail 2006). In some developmental theories, such as Piaget's theory of cognitive development, the way an individual interacts with his or her environment is qualitatively different across each stage (McGonigle & Chalmers 2006). In addition to the qualitative and behavioral differences seen in the developmental stages there is neurophysiologic evidence using fMRIs that shows different brain regions being qualitatively different for children, teens, and adults while completing cognitive processes (Thomasan et al 2009). Knowing that there are qualitative and quantitative differences in how individuals process information while developing suggests that these differences should be considered when selecting, introducing, and training AT to each individual. Accordingly, the best way to introduce an AT might be different for a child and an adult.



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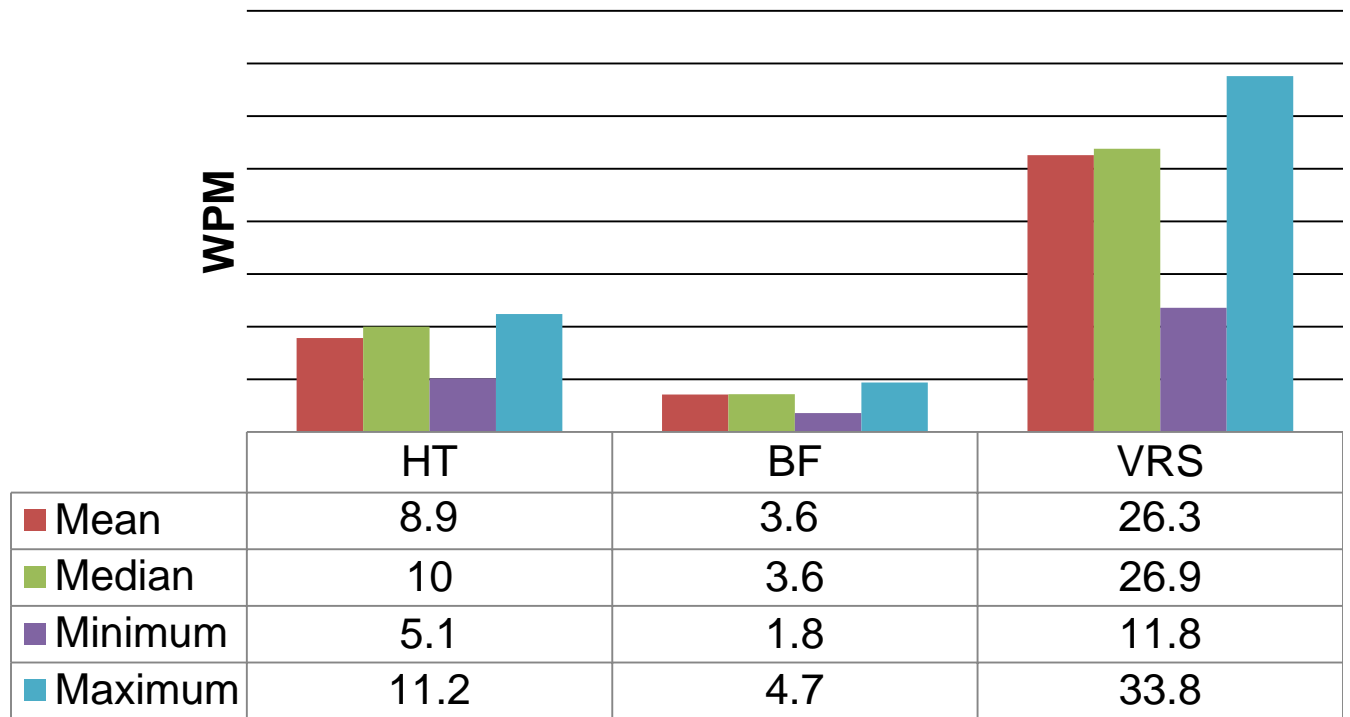
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## APPENDIX A

### FIGURES

# Descriptive Statistics of Typing Performance for Part 1



*Figure 1.* Descriptive Statistics of Typing Performance for Part 1

# Typing Performance Learning Curve for Part 1

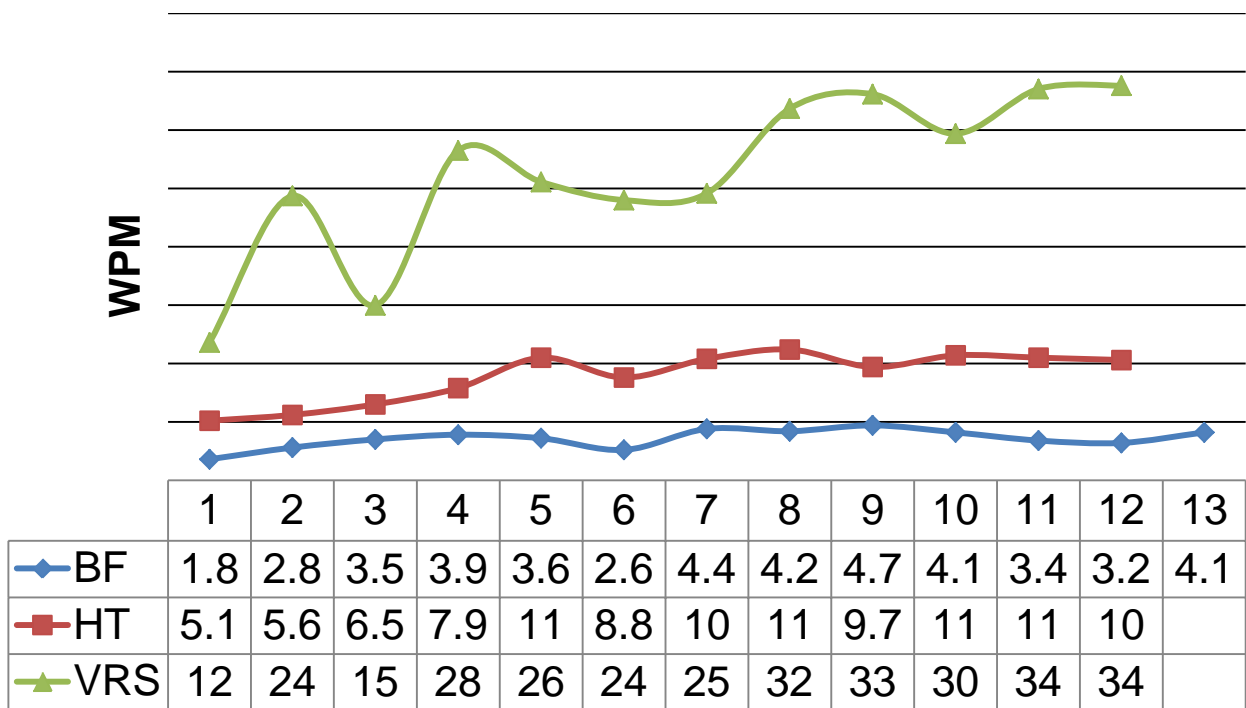


Figure 2. Typing Performance Learning Curve for Part 1.

# Descriptive Statistics of AT Errors Part 1

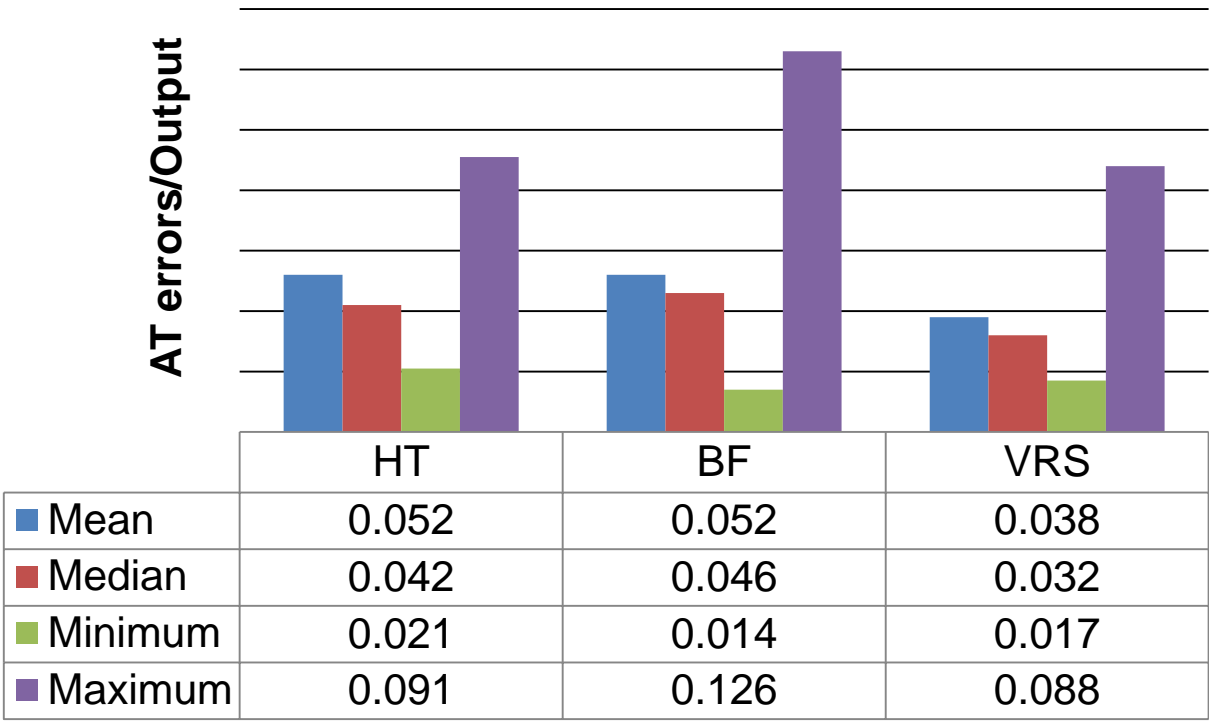


Figure 3. Descriptive Statistics of AT Errors for Part 1

## AT Error Ratio Learning Curve for Part 1

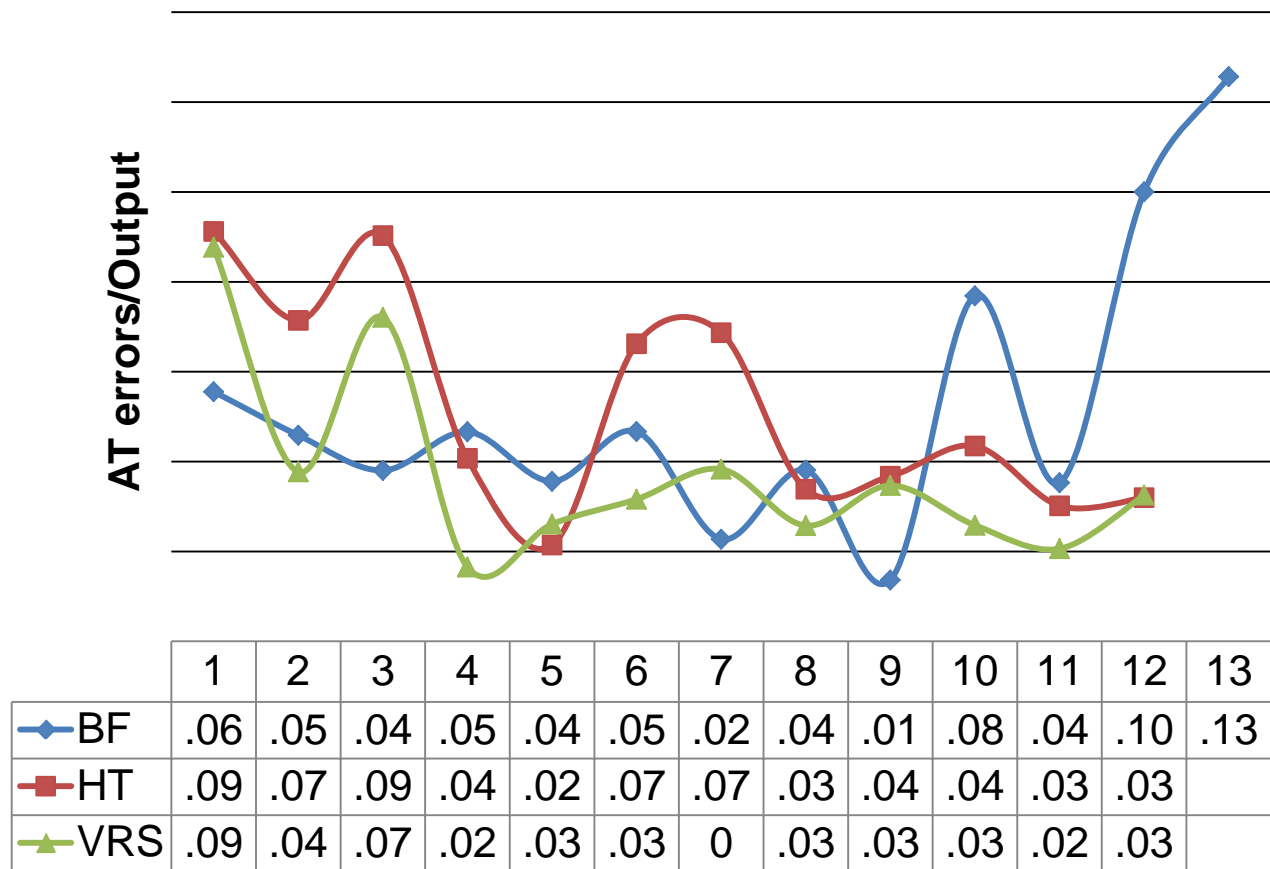


Figure 4. AT Errors Learning Curve for Part 1

## Descriptive Statistics of Typing Performance for Part 2

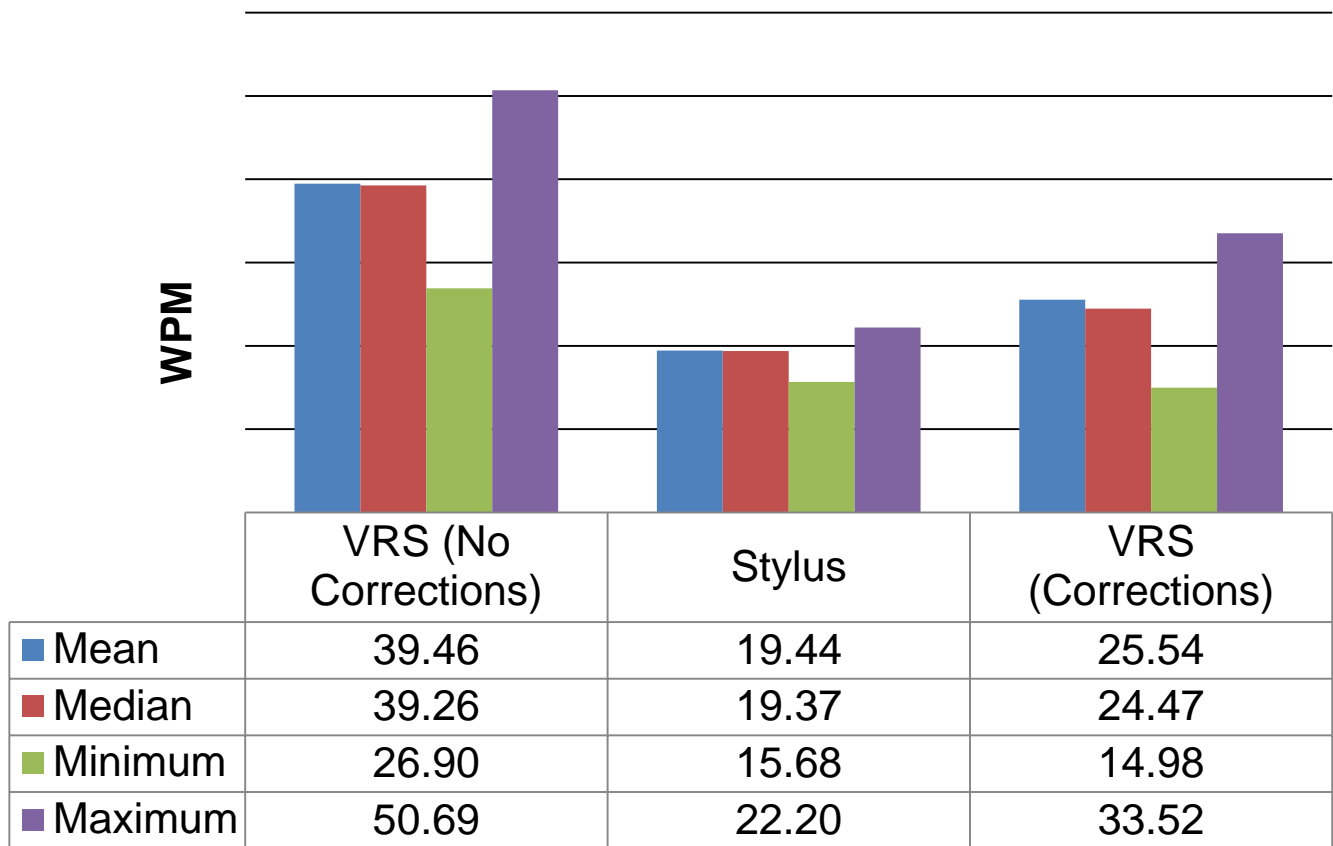
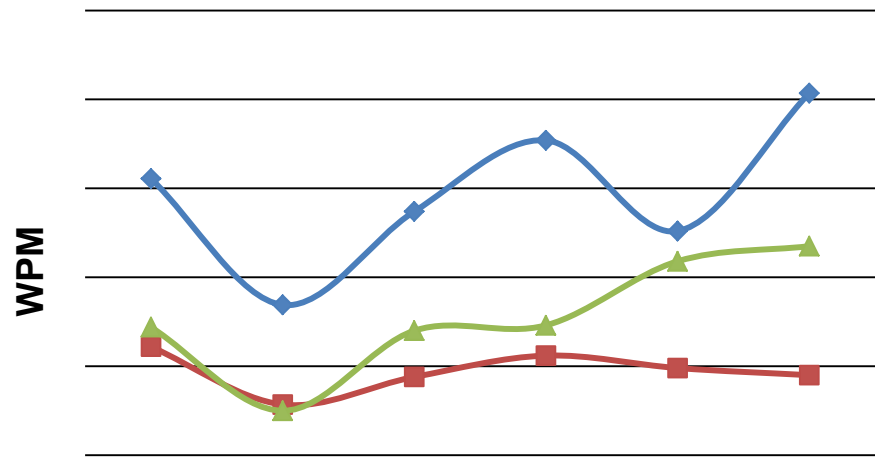


Figure 5. Descriptive Statistics of Typing Performance for Part 2

## Typing Performance Learning Curve for Part 2



	1	2	3	4	5	6
—◆— VRS (no corrections)	41.1	26.9	37.4	45.4	35.2	50.7
—■— Stylus	22.2	15.7	18.8	21.2	19.8	19
—▲— VRS (corrections)	24.4	15	24	24.6	31.8	33.5

Figure 6. Typing Performance Learning Curve for Part 2



# APPENDIX B

## TABLES

<u>Descriptive Statistics</u>				<u>WPM</u>						<u>AT Errors</u>						<u>AT Error Ratios</u>					
AT type	<i>n1</i>	<i>n2</i>	<i>n3</i>	<u>Test</u>		<u>Journal</u>		<u>Total</u>		<u>Test</u>		<u>Journal</u>		<u>Total</u>		<u>Test</u>		<u>Journal</u>		<u>Total</u>	
Head				<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
tracker	6	6	12	8.50	2.22	9.37	2.17	8.93	2.14	24.33	8.52	15.17	5.27	19.75	8.28	0.06	0.03	0.04	0.02	0.05	0.02
BF	7	6	13	3.29	0.85	3.88	0.69	3.56	0.81	8.29	3.68	7.33	4.68	7.85	4.02	0.06	0.02	0.05	0.04	0.05	0.03
VRS	6	5	11	27.03	8.06	25.55	6.63	26.29	7.08	54.33	27.90	45.83	17.68	50.08	22.71	0.04	0.03	0.04	0.02	0.04	0.02
Total	19	17	36	12.43	11.33	12.93	10.20	12.67	10.65	27.89	25.06	22.78	19.97	25.41	22.56	0.05	0.03	0.04	0.03	0.05	0.03

*n1*=typing test sample size

*n2*=journal sample size

*n3*=total sample size

Table 1. Univariate ANOVA of all sessions and session types for Experimental Part 1

<i>Source</i>	<i>Dependent Variable</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>Sig.</i>
Between Groups: AT type	WPM	3458.68	2.00	1729.34	89.41	0.00
	AT Errors	11692.96	2.00	5846.48	29.47	0.00
	AT Error					
	Ratio	0.00	2.00	0.00	1.27	0.29
Between Groups: Session type	WPM	0.00	1.00	0.00	0.00	1.00
	AT Errors	355.12	1.00	355.12	1.79	0.19
	AT Error					
	Ratio	0.00	1.00	0.00	1.39	0.25
Between Groups: AT type * Session type	WPM	9.98	2.00	4.99	0.26	0.77
	AT Errors	131.10	2.00	65.55	0.33	0.72
	AT Error					
	Ratio	0.00	2.00	0.00	0.65	0.53
Within Groups	WPM	599.61	31.00	19.34		
	AT Errors	6149.10	31.00	198.36		
	AT Error					
	Ratio	0.02	31.00	0.00		

\*p<0.05

Table 2. Univariate ANOVA of all sessions and session types for Experimental Part 1

,

AT Type	<i>n</i>	<i>M</i>	<i>SD</i>
VRS (no corrections	6	39.46	8.30
Stylus	6	19.44	2.27
VRS (Corrections)	6	25.54	6.63
Total	18	28.15	10.44

*Table 3.* Assistive Technology Performance Means and Standard Deviations Experiment Part 2

<i>Source</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>Sig.</i>
Between Groups	1202.71	1.00	1202.71	32.52	0.00
Within Groups	369.80	10.00	36.98		
Total	1572.51	11.00			

\*p<0.05

*Table 4.* One-way ANOVA between VRS and stylus typing

<i>Frustration</i>	<i>Problem</i>	<i>Journal #</i>	<i>Level</i>	<i>Solution</i>
Independence	Setup required another person's assistance so I had to schedule ahead of time when I worked	10	10	VRS allowed the most independence because I could set it up on my own, it was in my own personal space, and solutions to technical problems could easily be searched online and in the community of students with disabilities on campus. BF did have good technical support because the creator and other expert users were easily assessable.
Workstation/ Equipment Maintenance	Equipment would get moved or adjusted and if I couldn't do it myself I had to get someone	4	5	
Technical Equipment/softw are Maintenance Support	Programs/equipment would randomly stop working and I couldn't do it myself	6	3	
Output speed relative to Cognitive speed	Multiple complex ideas would occur and I could not write them down quickly enough	5	10	VRS had the fastest typing speed and was relatively easy to get raw ideas out quickly without losing a lot of information. Many errors occurred, but easily fixed since the content was written down.
Reliability of AT	The AT would have random errors or not work correctly	5	7	VRS worked 99% of the time at decent performance rate. There were times it would not correctly understand words or my voice, but I could easily adjust how I was speaking or use different commands to accomplish my task.
Not usable	Extensive process occurred to fix the problem or the task for that day had to be stopped for the whole day	4	8	
Alternative solutions	AT had errors but there were many alternative, easy ways to fix the AT	3	4	
Personalization	Needs/wants of the AT that varied from aesthetics to function to preferences The AT either did not have the necessary functions or functions needed to be formatted differently.	7	4	The HT had multiple onscreen keyboards it could work with that had many options for personalization (color, keyboard shape, layout, keys used, multifunction keys, etc.).
Internal negative emotions and thoughts	Thinking and feeling resistant to the new AT.	2	6	Accepting the need for change.
Physical and Mental Discomfort	Headache, other pains, as well as physical and mental fatigue, Extremes manifested by stopping session.	3	4	VRS caused the least physical and mental discomfort. Never stopped sessions with VRS. Often did with the other ATs.
Cursor Control	The ability to move the cursor fluidly and select items efficiently		4	The HT was the best AT for cursor control. The HT's cursor moved fluid with my head movements & selections were easy to do with my thumbs pressing the necessary buttons

*Table 5. Explanation of Frustrations Using Assistive Technology*

## APPENDIX C

### JOURNAL ENTRIES FOR VRS, HT, AND BCI IN EXPERIMENTAL PART 1

#### VRS Journal Entries

##### VRS Journal Entry 1

December 1, 2009 2:48 p.m.

this is the first journal entry of many for my masters thesis. I'm here to discuss the different strengths and weaknesses of using different computer-assistive technology for typing and basic computer use. Yesterday was my first day collecting data. I thought I had everything figured out in all three of the different system technologies for typing, but I was dead wrong. Earlier in the day, I tried using Brainfingers, but it was a complete fail. The key logger I was supposed to be using with Dasher did not work, so I had to find a new way of measuring typing speed with Dasher. I did find a typing program where the testing feature is completely free and I am allowed to add my own text to it, which is very good. This program allowed me to still use Dasher and collect the data that I needed to. The most difficult thing was to figure out where the most efficient place the windows should be on the two monitors. I wanted to be able to look at Dasher, but still be able to see the window that I was typing in. Even though, I have two big monitors which are wonderful to see things on, I still felt it was difficult and cumbersome to look at both monitors. At one point, I thought you'd be best if we had one monitor on top of the other monitor or perhaps have one really tall landscape monitor where I could put the two screens and need on top of each other without any visual interference of the hardware of each screen. In the end, I decided to put both of the applications that I needed on one screen that was to the right of me. I'm starting to wonder why I do not like using the two monitors. It is nice, but I feel like to be able to use both screens I have to move my whole body to see them comfortably. Perhaps it could be because I am extremely close to the screen due to having to be able to reach the mouse. The mouse to that computer is a pain in my ass. I know I have a trackball that I could use and I like to use it, but I find it difficult to always carry it around to all the different computers I have to use it with. Another problem I have is that even if I do carry it around, I have to then plug it in and most of the time the computer USB ports are already used or in extremely hard to reach areas. I know a way to fix this problem could be telling other people about it or having somebody in the beginning helping me set up and plugging in the trackball for me. The solutions, although easy are difficult for me to use. My difficulty stems from the feeling of being a nuisance and the frustration that comes with always being dependent on somebody. I know I have to accept that I need peoples help. I also know that even if I do receive the help, I get frustrated having to ask for it even if their job is to help me. I know I have the right to have help, especially if I am paying them, but it's still a big issue for me. I think it is a big issue, because of how I've been told by society that I am needy and should be grateful for what I have but also have been told that to be a strong independent person I must try to do everything on my own. So when I am given the opportunity to use any assistive technologies I want and receive all the help that I need I am torn. I know in some ways that using assistive technology can really make my life better, but I have to give in to the fact that I need them and be confident when discussing them with other people. For example, even though assistive technology, can help me, I want others to know that he does not always make me completely independent and that no matter what

I will still need other people's help. I just don't want to have to feel guilty for having to have other people's help. This whole issue is not just related to the assistive technology, but my whole life as it relates to having a physical disability which should be discussed in a broader journal.

Anyway, I should probably get on to other things I've learned using the different assistive technology on the computer. While I was working with Brainfingers yesterday I couldn't get the system to work right. I am unsure whether the problem was me or the system. Usually I would think the system because we got off day on the software, but the software was working okay. I thing just seemed a little bit off and I cannot control the cursor as well as I usually could. Dasher was also messing up a little bit when I changed the options to input text right into the application I needed, not into what the Dasher application. So after three hours trying to work with it I gave up. I had a huge headache, my forehead hurt, my brain actually hurt, and I had to go to the bathroom. I knew that I would have a little but of a headache and that my brain would ache because I had not used Brainfingers for an extended period in a long time. I however did not expect my forehead to hurt. I knew once I put the headband on, that it would hurt afterwards because the person that put on me didn't put it on right. The person I asked was very nice about putting it on and tried to get it right, but I could not tell what was exactly wrong with it and what to tell the person to do to fix it. I know the person I asked what had been completely comfortable working with me until it was right, but I personally did not want to put the effort into trying to figure it out. The reason why I didn't want to put the effort into it wasn't just because I am lazy but I did not want to have to go through the lengthy process of trial and error until was just right. This is because I know that next time I will probably not have this person helping me again and if I do I would have to go to the process again and then waste that much more time. Some would say it is not wasting time if it makes you comfortable, but for me when I do things comfort is not my first priority, functionality is. I feel like all of my life I have to make things functional before comfort and preferences. This is now making more sense to me why people without disabilities don't understand my thinking process and how I make my decision to do things or how to do them. For other people who have more functioning of their arms and legs there are many different products programs and methods that they can use to be able to get an action completed. They are given the choice what to use and not only the choice, but the ability to customize without having to defend their reasons why and fight for what they like. I often hear people saying, "Jenny, you have to realize that if using ABC technology does 99.9% everything you need and works good you must compare the good versus the bad and use it because it has so much good in it and it is the only thing that you have. So suck it up and use it and be grateful that something like this actually exists" I will listen to these people and acknowledge that they are somewhat right, but it is frustrating that I have almost no options but to use it and if I don't use it then I am hurting myself much more than it is worth. An example of this that pops up in my head is when getting a new cell phone. I would love to have a smart phone or iPhone, because I know the applications in it would help me tremendously. The two biggest things I would like to use in these type of phones are the calendars, Word processing, and e-mail. The calendars and word processing of the most important because currently I do not have a method that enables me to do this. I always see in meetings other people who have their little notebooks or calendars with them that they can carry and jot down anything that they want that is important in the meetings. Then there's me who just walks in with nothing but a smile that tries to remember all of the important things in the meeting. Yes, I can write with my hands and I could ask somebody to write for me or get things for me, but the process to do that is

extremely difficult and material heavy to do. This is why when you see other people who write down these things have a small notebook or their own technology that can fit nicely and easily accessible in their pocket. For me, what would make sense would be to have a smart phone because it is small enough that I can carry it around and make it accessible to me while it would have all the features that I need. The problem however is being able to use the phone functionally. Currently, I use a Samsung eternity touch phone. I have found that I can type best on the touchscreen, but only on one's that do not use capacitive touch which is why the iPhone is difficult for me. Also, I could technically use the smart phones that have regular keys but once again the every day interaction with the device is such a pain that it is not worth getting even if it has the applications I need. I would be more likely to not use the applications which would defeat the purpose of having the phone in the first place. So in this example the phone I currently have has 99.9% what I need in a phone, but it is definitely not the best for me. I give this example because I hear many people in the program discuss their phones and get in a huge discussion about why they are not happy with their phones and feel that they have the "right" to have what they want over a issued they do not like about their phone. One issue that I often hear is that they do not like a certain color their phone came in. When I hear this I just want to strangle these people because in my head I'm thinking, "dude, your phone has technically everything that you need and does way more than a phone is functionally supposed to do just like how my phone works for me (functionally speaking), but you tell me I need to get over it and accept that this is what I have to deal with. However you who actually have all of the features that I would love to have (features I want for the same reason as you do and the ability to be more independent in other areas of my life), are complaining about something that is completely related to personal preferences. Yes, I agree that we can have personal preferences, but don't give me the line that I have to deal when in essence you yourself stated that functionality is the most important. You have the functionality of your phone perfect."

Wow, I never wrote so much about things that I had not thought of  
4:19 PM 1:21:59:73

## VRS Journal Entry 2

December 7, 2009 6:28 p.m.

Today was my second day of data collection and it went a lot better than before. I have been noticing that I am unable to write down all of my thoughts in my journal in the one hour time frame. The last journal entry could only be 40 minutes because I had to leave to get my coat on. I'm realizing that the most difficult thing in using these different technologies is the part where I have to depend on others. I will admit that I am lazy and do not like to get up in the morning so I start my day off late which does not give me a lot of time to do work if I depend on others who get off work at 5 p.m. in my defense getting up later is easier for me to schedule PAs and to actually have them accountable. There are some PAs that do come on time if it's early in the morning but their work ethic and ability to function sucks. Of course it is these PAs that can't function that are the most available and I cannot get it through their head the specifics to what I want. They will argue with me over what is best for me to do for my body and I just want him on the head and say to them, "you idiot, can you just shut your mouth and do what you're told without bitching. I know my body well enough that I do not need you to tell me what is right for



it and most importantly the way I do things is not the best for my body but actually I try to make it the best for you." So this is a huge reason why I like to get out late, probably more than me being lazy.

I'm going to try to continue with what I was writing in the last journal so I can catch up with all of the thoughts I've been having. I believe I was talking about my crappy day trying to use the head tracker. That day before I even went to the LWD lab I had asked that same PA to go to the lab to put the dot on my head and to take me to the bathroom. I thought it would be good to hit two birds with one stone, especially since she was working in the basement of the student union at the exact same time and after work was supposed to help me go to the bathroom at the same time. Of course, since she is a pain she said no to going to the lab but would help me in the bathroom. So, once I got into the lab the head tracker was knocked off and I had no way of reaching it. The desk that the computer and head tracker was put on the accessible one that was the tallest desk in the lab. I know I could have reached it and put it on if it was the same height as all the rest of the desks. I knew the accessible one was supposed to adjust heights, but I had never been able to get it to work. I always found it ridiculous that for most people that need accessible desks can never get it to work. Actually before today in the lab when Clark adjusted the high in the desk I had never seen any desk adjust that had the side crank.

I have to add a side note. There would be times in the lab in the basement of the library that my friends and I (disabled and able-bodied) would want to adjust the desk but could never get it to work. We would try all different ways. Our first thought was to pull the crank out, so towards you and then turn it clockwise or counterclockwise, but then we tried to do that the crank would never pull out. So then our idea was that there may be a spring or some other gadget inside the crank that instead of doing a complete revolution you only did half revolutions which would make the crank go up and down. Of course that did not work either. Then usually we would get so frustrated and mad at it that we would start laughing and taking our writing utensils or other things in our hand and pretend they were wands

### VRS Journal Entry 3

December 16, 2009, 12:53 a.m.

Today's session went really well using Dragon. I felt for the most part that it was pretty efficient. I do notice that using Dragon and using head tracker that there appears to be significantly more errors as the words per minute increase. I know that you would expect to have some increase in errors, but I think that there is a lot more using Dragon and head tracker than Brainfingers if you were to put the words per minute and errors in a ratio. I should probably do that in the future. Something else I noticed today using Dragon is that when correcting words in the dialog box dragon almost always messes up what I'm trying to say even with easy words that it never messes up when I'm dictating in DragonPad. In order to get the dialog box to type what I want I have to say each letter by itself. For example if I want to spell the word hat I would say, "spell h, spell a, spell t." I must say that it was very difficult to write that because the word "spell" when said by itself is a command that brings up the dialog box that I stated above and when I say "spell 'X'" that is also a command that then types out the character. In a way, it was fun trying to

figure out how I could dictate worse that are also commands without the command occurring. When I started out today I noticed that my computer was moved a little bit since last time I used Dragon, which made me a little bit farther away from the microphone. I wondered how much it would have an effect on how the microphone picked my voice up. The microphone picked up my voice probably a little better than before and I think the reason is because I was facing the microphone at the same angle and only a longer distance away than usual. I am usually 18 inches away from the microphone, but the computer tells me that my voice is too loud for it. It's like this even when I whisper. I decided not to care because it is still working pretty good and I cannot see the computer if I moved it back much farther.

Something else that I've tried today was using the newer commands to actions that I perform. For example when I wanted to change the text wrapping on here I said "view" instead of saying "click view". The newer commands did not always work so I will continue using the old commands. I do have to say that when I would just say "view" and it would open up the view menu bar I got the cool "ooh ahh" feeling that you get when you see new technology or something else that is innovative. I wonder why I got this feeling since saying the old commands produces the same action as the new commands. Something that really frustrates me when using Dragon is that the best way for it to transcribe what I am saying I have to use DragonPad instead of Microsoft Word. DragonPad does have some formatting to it but the biggest thing that bothers me with formatting is the text wrapping and the ruler. I have always had this love-hate relationship with rulers on wordprocessing programs. A long time ago I used to use Corelle WordPerfect and if I remember correctly I hated using it because of the rulers. I also remember that when I was first introduced to Microsoft publisher I was absolutely in love with it because it had grids and a crosshair line on the document wherever the cursor was. I loved it because I cut a line everything exactly the way that I wanted it to and I also loved that the different margins I made with the rulers had different colors to represent the different things. This was especially helpful when I was making flyers or other crafty things on the computer. I remember one time I got so frustrated because I was aligning different pictures and in the bottom row one of the pictures was literally three pixels off from the other one. I did all that I could but I could not get the pixels to align correctly and when I presented the finished project (it was a Christmas gift) one of the first things I said was that the picture was not aligned and it pissed me off. Can we say anal-retentive much? On a random know, I have noticed that Dragon does not recognize swearwords of almost any form. When I say a swear word it will have a word that in almost no way sounds like the word I was trying to say. Also, when I try to correct it in the dialog box I will start spelling out the word and it is never predicted in the 12 or so predictive choices. I guess this means that the Nuance did not want any potty mouths using their software. I guess I could go in to the editing applications and train it to know what the words but to be honest I am a little too lazy. One thing that I really should train or at least know what the name of the abbreviation I use "e.g.," in the last text entry I had to spell that out character by character and correct it almost each time and boy was it a pain in my butt. I dread typing that the abbreviation out. I thankfully remembered for a nether abbreviation "and" is named ampersand or better known as "&." I have to say that I had to spell that word out letter by letter because each time I said it, Dragon thought I wanted the abbreviation. I was just thinking about how the system would react to other punctuation and realized that for most punctuations I will have to spell it out. I did just do a test on what would have been when I would need to use the word period and found that sometimes the program will spell that word out especially if I use it in the context like

"I found that three periods ago..." but the first time I used the word "period" I had to spell each letter out. This time when I used it in the quotes I could just say the words correct period and it had the word written out in the first option in the correction dialog box.

I have to say that using this system at night is okay except for the fact that if I did not know better I would think that my computer was tired and was acting slower and more sluggish. I say this because even in DragonPad the application is not working as good as it usually does. It is messing up what I am saying more often and not just that but it's is not doing the commands or even writing out anything after I say something. Also it is writing out words in the application that is not the same as the little square dialog box that represents the words that I said and should be the exact same as the ones in the application used. My only idea for why this is happening is that my computer currently is extremely hot and has been on for a long time. So yes I got a big break, but my computer did not. Oh I should also write that I was using Yahoo messenger with this and it worked extremely well. Honestly, it worked better than it even does here in DragonPad. I really wonder why it is. What made it seem like works so well is that it first got almost all of my words correct, correcting the words that were incorrect was extremely easy and I did not have to take a lot of time doing it, and it recognized majority of my commands extremely well. Yes, it definitely recognized the commands better than it did in other applications. I just did another test seeing whether the DragonBar would actually recognize my commands and do what it wanted. The crazy thing is that it opened up the menu bar but when it got to the dialog box dragons said in its "<???" dialog box that it did not understand what I was saying with any words that I said. Isn't that ironic?

1:25:08

1:01:44:67

45 errors

#### VRS Journal Entry 4

December 16, 2009, 12:55 p.m.

I did the last text entry earlier this morning and it was definitely one of the hardest/worst that I have done. I think there were a multitude of different reasons why it was so difficult. When I decided to do it in the early morning I thought that the results may actually be better than when I do it in the afternoon or evening since I would be refreshed from a night's sleep.

One of the reasons the last session was difficult was because Dragon was not recognizing any sounds that I was making. It was having similar problems as last night when I was switching from Yahoo messenger to DragonPad. Just a reminder if I did not say it before what was happening was that the microphone did not pick up anything and the little sound signal that changes from yellow to green to red was not moving at all. I thought that the problem was because my computer was getting really hot so I decided to turn it off last night to try to alleviate the problem. However, this morning it was having the same issues. So to fix it I moved the microphone line wire from the back plug in the base and moved it to the side one that is on the main computer. This made setup time longer. Set up time was actually really long because I

could not get the counter to sit right underneath my arm which really really frustrated me. Another reason I think the last session was difficult was because my voice was a little bit groggy. My mind was fully awake and I felt like I was functioning okay, but my voice was a little bit off. I was having a hard time pronouncing a lot of the words the way I usually do. I have been noticing the more that I use this that my accent seems to be more Michigan like. All of the tiny pronunciation differences become very apparent to me because I am focusing on what I say and how I say it so much. I know one problem with my voice today was that many of the words had the R. sound that I had to go to speech to learn how to do when I was younger. The word that kept on coming up was "error." So when I was saying it for tracking to dictate I had to say it very slowly and by itself so I could enunciate it right. Of course when I would say it each time I would say it louder than I would other words so Dragon would mess up because it was not used to my louder voice even though the word was pronounced much better than before. I know that Dragon is supposed to adapt and get used to my voice so the weird ways I say things and should be used to, but I know that it has standard knowledge of what the words should be dictated like. So, the R sounded words were a pain in my butt.

So I have to add the little problem I am having currently with Dragon while writing this journal. In the middle of this journal a dialog box popped up saying that Dragon could not hold any more data in this session. That was fine with me because I did not need it to save any of my speech files so I just clicked okay and thought that I could be on my merry way. I was wrong. Each time I tried to dictate something that stupid box would come up and interrupt what I was doing, so I decided to just restart Dragon. So after a few minutes of logging out of everything and saving the user files it did have I finally got all logged out and was ready to restart it. Well, Dragon did not agree with that idea. I tried opening the program at least 10 times and the computer said it was opening up but a window did not appear. In the midst of this frustration I decided to just log off of my computer instead of restarting it so the programs could be restarted and I did not have to go through the whole setting up stage of Windows. Of course when I logged off the Dragon window finally appeared 10 minutes after I had selected it the first time. Stupid dragon. Finally after at least 15 minutes I got Dragon to start working again. One thing that I wish Dragon did was keep my settings from the previous time I used it. For example, I wish that it can't the window size of DragonPad the same and it would keep the text wrapping the same as before. I mainly like these things to be the same not out of functionality but I'll of personal preference and my own anal retentiveness.

With all of this frustration of using Dragon this morning and currently I am having a hard time remembering what I want to write about. The biggest things that I remember that I wanted to say was that when typing out unfamiliar words or words that I just cannot pronounce but know the meaning of, Dragon is difficult to use because I have to spell out each word character by character. This is also the same for certain punctuation and symbols because I have no clue what the official name to them are. Right now I kind of feel like Dragon is slightly annoying to use because it does not seem to be much faster than my normal typing and I lose my train of thought quite a bit. Even so Dragon is faster than head tracker or Brainfingers I feel like I have a better focus because I am continuously cognitively thinking or doing something with the head tracker and Brainfingers. With Dragon, I feel like my thoughts are put on pause because I have to wait for the computer to process things. Yes, I can dictate a lot at one time in a long string, but I have the habit of having to reread what I write to make sure that it typed at least most of

3:06:33  
45:48:14

### VRS Journal Entry 5

March 1, 2010,

I'm so glad I have the head tracker working again. As I said in the journal I made with the head tracker and the new on-screen keyboard, I think that the new keyboard will work pretty good once I get more practice with it. However, I have absolutely zero motivation to type out what the strengths and weaknesses of the new keyboard with the head tracker. I definitely didn't like the new keyboard in comparison to the WiViK one that used for only a little bit. I really liked all the options that I had with it and that it looked aesthetically pleasing. One thing that made me like it way more than WiViK is that it was much easier to press the keys on the keyboard and have the application actually recognize it. For some reason when I would use WiViK, I would have to have the mouse cursor extremely still in order for the program to recognize that I press the key when I clicked on the mouse. This stillness caused a lag in productivity and was a pain in my ass. Also, this new keyboard made me feel like I was actually using a physical keyboard that you use with your hands. I had never had this feeling before and I really enjoyed it. It made me like the transition better than with other keyboards. There were two difficulties I had with the new keyboard. The first one is that when I pressed down on a key by clicking on the mouse it does not stop pressing the key until I let go of the click. This is nice, because it is like on a regular keyboard. However I am used to most on-screen keyboards not doing this, so I have to adjust to it. I like that it does this because it allows me to make less actions. However, if I forget to let go for a split second, many other keys are pressed. Thankfully, it is easy and very quick to delete all of the extra keys. Actually, when deleting the keys so quickly I became very happy because it was so quick and required less movement by me. So this difficulty is both a good and bad one. It probably is a little bit better than it is bad because the correction for error is electively small compared to the ever on the "normal" on screen keyboard. The second difficulty that I have is that my hands are getting a little tired with all of the clicking. Wayne was right about causing a repetitive motion injury in my thumbs using the mouse the way I currently am using. I know that was one of the biggest reasons why I did not want to write more in my journal entry yesterday. I tried switching thumbs for the clicking which helped a little bit, but not much. I know Wayne mentioned having a quicker that I can use with my arm or foot, but I do not know how it is possible. For me to make those movements I am pretty sure I have to move much more of my body that I would like to pour a small movement. I say this because if I use my foot I must crush with a mic or so because my ankle and knee is fused. And then to move my arms I must move my whole torso because they do not have independent movement from my torso. The only thing that really has independent movement is some of my fingers if they are in a certain position and my neck and head. This gave me the idea that using Brainfingers for clicking would be a good solution. I think for production purposes Brainfingers and head tracker would be a good combination, but I do not know realistically if I would use it or not. A big thing that's stopping me from using Brainfingers is that I need help for setup and putting the headband on. The second thing that's stopping me is that I really would not like to use the headband for

aesthetic purposes.

Before I forget I want to mention what combinations I am liking for the new interfaces. I believe for my home personal space Dragon seems to be the best for typing, although it is slower than my stylist typing so far. I do not like to use it for any desktop control. It has too many idiosyncratic commands that take too much time compared to just using a mouse. For desktop control in this situation I am debating between the head tracker or just using a trackball. If I ever do use the head tracker for a system, I would absolutely love to get an extra pair of glasses that could always have the dot on the glasses. Currently, the dots actually matches my frames wonderfully, but I still wish not to have to wear it all the time. It would give me a little bit of pleasure if I was able to have "work" glasses and everyday glasses. I say this because I currently have a "work" outfit/hairdo that I wear when it is crunch time and I need to do a lot of hard-core work. I did this for two reasons. One being that I wanted to be more like Jo March out of Little women who also had a uniform for when she was doing deep thinking and writing. I absolutely loved her when I was younger and felt like I could relate to almost all of her situations perfectly. The second reason I like having a work uniform is that I have turned it in to a classical conditioning environment that allows me to mentally and physically get in the zone to do work. All of my PAs and friends laugh at it, but I highly enjoy it. Now that I think about it, most of my uniform actually serves a functional purpose. The biggest thing that is in my uniform is my doctors cap or bandanna. I wear this so that all of my hair including my Asian wispy's are out of my face and do not itch, bother, hurt my head or my face. When my hair's bother me all I can do is obsess over them which causes me to be less productive and less focused on the work that needs to be done. The sure that I way or is usually one which has a bigger impact and is relatively loose on me so it does not feel like it strangling me. If it feels like it's too tight I will also obsess over it and not get any work done. I usually wear my super big gym pants so that if I have to go to the back and I can do it easily and quickly without interfering much of my thoughts. Okay, enough about my uniform. Whether I use the head tracker or trackball for desktop control, I will probably also have up or at least minimize an on-screen keyboard that I can easily, quickly, and with the least amount of excess movement fix the errors that Dragon will make. For a travel interface or one that is for temporary use I am thinking about using the head tracker for all tasks. So far, it is not the most productive, but it is reliable and not too stressful. Also I think it will have an easy setup. I would most likely use this interface if I was on somebody else's computer or was in a meeting. A big part in selecting this interface would be that the items I would need our small, lightweight, and extremely easy to set up. I also have a lot of flexibility when using these items.

I have to get going, but I am reminding myself that I need to talk about the typing speed of just using one finger and the reasons why it does not work the best. I also needs to talk about how it was difficult to type on Dragon the word cap.

Setup: 25:03s

Typing: 42:50: 73

Errors: 35

## VRS Journal Entry 6

March 10, 2010

It has been a few days since my test. The biggest change since then has been the weather. Today it is about 62° out and is lovely. I am slightly worried with how Dragon is going to be asked because I have the fan on which is right above my head and is making a lot of noise. I know I am already compensating for it by talking a little bit louder and clearer in usual. I probably don't have to, but I do not want to have to fix more mistakes that I already have to do. I get the sense that the system is just picking up a little bit more background noise than usual.

The last time I used this I was extremely exhausted. I did not check out the results, but I felt like I was slower in speed and made more mistakes than usual. It was frustrating and I just wanted to quit. However, it wasn't frustrating enough that I wanted to kill the system. Thinking about killing the system, it reminds me of the last experiment session I did with Mallory holler. She wanted to try Dragon with the array microphone. She has a physical disability, visual impairment, and hearing impairment. She communicates through a special type of sign language and verbalizes what she wants through her voice. You really have to understand her and her language skills to be able to understand her. I do okay understanding her often listen to her translators. Dragon did not work the best for her although she said she used previous versions okay. I used the computer that is in the CCL lab which has always worked great for me, but yesterday it decided to act up. At first I could not get the audio to work right even for myself. Second, it did not even have any decent guesses for Mallory's words. Some of the words that she was saying during training really did sound like what she was supposed to be saying. As a side note, I am realizing that this system is having a difficulty with picking up the beginning and end of my words. My hypothesis is that it is being drowned out by the white noise of the fan and outside environmental sounds. I know it is not very hot in here, but once any spring weather and especially summer weather comes I just love the feeling of crispness around me. Man, I am looking outside, I cannot wait to go run and play out there. Anyway, back to Mallory. For me, it was frustrating trying to figure out different technologies that may work for her. Earlier in the week I had tried to use Brainfingers, but I could not get her muscle signal to come down. She is always moving her head and face. We tried to set it for over 20 minutes but no success. Another difficulty was that she could not see any of the screen due to the colors. Her aides said that she could have seen some things if we could have made the window larger. I really think that in the future the color schemes of Brainfingers should be adjustable and possibly adjust with the settings that are in the Windows high contrast settings. Also, in windows Vista and in Windows 7 it is a pain in the ass to understand the accessibility settings, especially for high contrast. I know Windows was trying to make it easier, but for me it was made in a way that was too easy. I got extremely confused and wanted to kill the system. Why couldn't they have just given all of the options in one area without having to switch windows and switch settings boxes. The way that they haven't set up right now makes it where you do not know what your last actions were. Perhaps they have a more dance the way that's got all the settings out in one area, but I just couldn't find it. I doubt this but there is hope. Since I could not get Dragon or Brainfingers to work with Mallory, I decided to ask her some questions about her first year as a college student and how she prepared herself. This information will be used for Wayne's Project in second life.

The premise of what Mallory said was that she has been working with her or BSVI, and BVR counselors since junior high, but worked intensely with them the last two years of high school. I didn't quite understand all that they worked with her on and high school, but of what I did understand was that they would simulate some of college life and then make her decide what to do and then actually do it by herself. The biggest thing that was difficult for her when coming to write state was remembering all of the information needed to accommodate her disability. She is unable to write stuff down by herself so most of the stuff she remembers is all from her head. Her and her aid said that she has only made one scheduling mistake which is when she forgot to go to a meeting at ODS in fall quarter. Her nurse said that she did not understand how Mallory capped all the information organized in her head and how it all connected together. This made me smile because people have often said this about me to. Mallory said that she just uses little cues that are connected to something that she needs to remember or has a relationship with another important memory. This is often what I try to do and fail miserably at explaining to other people. I really would love to see and analyze how different people organize their thoughts and ideas. I wonder if the organization is independent with each person or there may be similar ways that people organize things due to the need to compensate because of ability level. I know for me, no one understands how I can go from one thing to another and remember the weirdest unimportant facts. I have tried to explain to other people that when I remember things I try to soak everything in so that for the information that I do forget I will be able to search for what I need through the cues that are strong in my mind. It is like completing a puzzle. The more pieces that you have completed in the puzzle with the best details, the easier it is to find and locate where the missing piece should go. But as I have said before to me life is just one long complex game that I love to play. I find it strange that I consider it life a game, but a hate playing games with an immense passion.

My PA is coming half an hour earlier than expected, so I'm going to have to cut this session short. Some things that I want to talk about in the next few journal entries is pride, guts, respect and dignity for yourself as an individual, but also an individual with a disability. I had a real eye-opener about this topic last Friday.

25 errors

1:37 set up

36:19 typing

Total: 37:58



## Head tracker Journal Entries

### Head tracker Journal Entry 1

Dec. 7, 2009, 4 PM.

Today is my second day of data collection, even though I did try 2 other days. The first time I tried using Brainfingers, but it did not work as planned . The first problem was that I forgot to check if any one else was using the computer. Jim was checking out Andrew's new software updates, so I had to wait an extra half an hour which was not too much of a problem. After Jim was done , he put my headband on

The second time I tried doing a session it was God awful! I was having a horrible time with mPA. She showed up 5 hours late. I know it is my fault for not waking myself up already. She did text me in the early morning that said to tell her when to come so technically I had a choice. I still found it unfair because we decided on 8 AM the night before. Anyway, after I woke up I fought with her because she wanted me to wait until she got all beautified, which was 2 hours later at 1:15. After I finally got up and ate I gootinto the LWD lab and automatically got frustrated. The computer with the head tracker had been moved and the tracker piece got knocked behind the monitor. I had a fee

### Head tracker Journal Entry 2

Dasher Crashed and all qualitative data was lost

### Head tracker Journal Entry 3

Dasher Crashed and all qualitative data was lost

### Head tracker Journal Entry 4

Dasher Crashed and all qualitative data was lost

### Head tracker Journal Entry 5

### Head tracker Journal Entry 6

April 28, 2010

I am so aggravated right now. I cannot find half of my journal entries for the head tracker. I know there was at least one or two that didn't get saved because Dasher shutdown due to some programming error. This is one of my last sessions using the head tracker and I'm very thankful for that. This thing has been giving me trouble from day one. It first was getting the dots for it, then getting the right keyboard, then setup was frustrating because this is a group computer. I know others did not realize doing small things like adjusting the height of a chair, moving a toolbox just a little to the left, or pushing a lever in would mess things up. I am also at fault because I should have emailed everyone telling them not to move or change anything. Honestly I don't think anyone would think or expect these things would matter or be changed. I do have to say that I do like the head tracker for regular mouse control. Changes in the setup barely affects

performance. Now that I have the typing setup I can tell that I like this best for the head tracker, but I do not like it for a system to use all of the time. Man, I can't help but smile when clicking the letters on this keyboard. There just is something about it that keeps me motivated to keep writing. It would be interesting to see how others with and without disabilities reviewed this keyboard. I wonder what layout people usually chose when using this keyboard and why. I know I chose "tight 2" layout because it is the mostspace and use efficient.cc

## BCI Journal Entries

### BCI Journal Entry 1

December 9, 2009,

Today is the first session using Brainfingers. I have tried to complete two sessions before, but could not because of time issues. First off, both times I had to set the Brainfingers profiles up, which by the time I got somewhere I had to leave. I technically had time to do more, but was constrained by needing someone to put my coat on me. I am much more disabled with my coat on because I can't pick anything up or lock the door in it. A few random things I have noticed so far is that knowing the location of characters, sequence they are in, and a

### BCI Journal Entry 2

December 11, 2009

Today's session of Brainfingers went really well. There were a lot less false click errors than last time, which was great. I was also able to increase Dasher's speed. The overall words per minute also increased quite a bit. I don't think this journal entry will reflect the high speed because I am stopping a lot to think of what to say. I am noticing that each time I use each assistive technology I learn new techniques that makes the device easier to use. A couple days ago I stumbled across a new on screen keyboard for tablet PC's. I downloaded a trial version of the software but have not used it much. Before I forget for the millionth time, I wanted to say that during all of my sessions I always have a million and one thoughts, but by the time I have a place I can put them I have already forgot them or it would make no sense in the text if I randomly added them. So what I am going to do now is write some of the thoughts down now. First off to use

### BCI Journal Entry 3

January 17, 2010,

I can't believe it has been over a month since I really worked on this last. I know I should have been journaling this whole time, but I didn't. I have had so many different ideas go through my mind, I'm not sure I can remember them again. I know a reason I didn't write is because I am lazy. Other reasons that played a part in not journaling is that I would not be able to get all of my thoughts out as quick as my mind was thinking them. I always feel like I must rush to write down my thoughts in the words that first pop in my head while it is raw. To me there is a real beauty in raw ideas, especially in doing research. To do science, one must think outside of the box and too often we see science in such a robotic technical sense that we lose sight in its function. I see science as an explanation of common sense. I must say that I'm getting really frustrated currently because I had so many different ideas on this topic, but I forgot the pathway I took to get them and I am getting a child like attitude of wanting to quit before I expend any more extra effort into

### BCI Journal Entry 4

January, 25, 2010

Today the Brainfingers profile actually saved from the last time I used it, which was very exciting for me. The past few weeks I have had a few meetings with Wayne and we talked a lot about what I could write about in my journals. I have had a few different ideas that I will talk about today. The first thing that is coming to mind deals with the frustrations that I spoke of last week. Wayne first suggested for me to make my personalized short hand way of whriting. I definitely understood why he said that, but what concerned me most was how it would effect my communication with others, especially PA's. It is already difficult to switch from my heard talk to my civilized and rational people talk. We also discussed how a person Wayne knows has a difficult time keeping PA's to work with him. To me it was really interesting because I have similar difficulties and could relate to the person a lot. A big problem that I have is that often when they come in I am in my own little world on the computer and in order to get any thing done I must transition back to the real world much faster, more completely, and more abruptly than the average person.

#### BCI Journal Entry 5

April 10, 2010

Today I am actually using Brainfingers using my personal laptop. It is the first time it has actually worked on here. I am doing the data collection on here because we are doing a demo tomorrow and my computer is the only one available. I won't lie , I am slightly annoyed that mine is used. The annoyingness is due to the hassle it is to take down and setup my laptop. It is not just a matter of doing it, but the physical stress it causes if I do it on my own or having to schedule a PA to do it.

#### BCI Journal Entry 6

APPENDIX D  
ADDITIONAL JOURNAL ENTRIES USING VRS ONLY USED FOR QUALITATIVE DATA

VRS Additional Journal Entry 1

December 10, 2009 6:31 p.m.

this journal entry I'm hoping to write about things that I have noticed during my first week of testing. I'm going to start out with talking about Dragon naturally speaking. Right away I noticed that the best program to type in is DragonPad not Microsoft Word which is difficult with any formatting that I need to do. I'm definitely starting to like using Dragon for minute simple tasks we are small errors don't matter too much. The biggest difficulty I have seen so far using Dragon is that Dragon itself will understand what I am saying and the little rectangular box will have written exactly what I want to say, but the program or application I am in is not actually do what I said. The second biggest problem is that in almost all applications except for DragonPad when I want to correct a word or select a saying the item will not be completely selected and when I try to fix it the be spelled within the messed up word. I don't remember having this problem before this week, or the problem was very small. There are also a couple of commands that it does not always do what I tell it to do the two commands are "press enter" and "go to end of line. "Also, today the backspace command is not working right.

When I am writing things using Dragon I am having to get used to Bulkley saying it and knowing what I want to say when I talk. This is difficult for me because I often will write things down and reread them and then change some of the words and read it again and then change it again until it is just right. I know this process is slow, but it seems easy. Also when I would type with my stylus I do not feel like I will be judged or have any pressure to say the right thing which is what I feel like it when I am in the middle of writing using Dragon naturally speaking. I'm pretty sure I know where this fear/feeling comes from. When I was younger the main way I wrote documents was by dictating what I wanted to say to my aid who sat next to me in almost all of my classes. When she would transcribe for me I always felt like she was judging me because she would make faces when what I would say didn't make any sense or to her was plainly stupid. Also, she would get really bored and act that way if I took a long time to write which caused me to have a lot of stress. So as I got older into middle school I would then just think about what I wanted to say before I wrote so it was just perfect. This process took a long time and I hated writing with all of my heart then. I had this aid for more than six years and I really don't think she knows what an impact she made on me when it came to writing and doing my school work. So now, when I use Dragon NaturallySpeaking I already have an automatic fear that I will be judged and I have to say the right thing when I type. Also I'm trying to get over it but I sometimes think in the back my head when I use this that no matter how I write it will suck. Another difficulty is being able to separate my normal focal conversation talked and my written talk. I'm pretty sure in these journals where I use drag and it will sound more like I'm talking to you than what the journal entries using Brainfingers or the head tracker.

I have tried to use Dragon for cursor control by using different commands and it has only gone okay. I really should get or print out a cheat sheet that has the cursor commands on it that I can put next to me. I did to look in the help me files of Dragon and saw some of the commands. I got a good laugh when looking at them because there are many different commands that perform

the same action but vary on user-friendliness. Of course, when looking at them the majority of the commands I use from a novice perspective are the least user-friendly. I know the reason why I use them is because they were the commands used in the earliest versions of the program that was trained on for months and wanted to kill at the time. So is similar to the technology getting better in the newer versions of Dragon the commands have become easier for people. I was thinking of trying to change my commands, but decided it would be too difficult for me to change what I have known for over 10 years. Now that I think about it, it probably wouldn't be too difficult but he would deftly take a lot of training. Even though I never became an avid user of Dragon I definitely use the commands in real life ever since I have been introduced to them. Just like how I forget that I have Brainfingers knocks on my head when I'm driving my chair and tried to drive it using my muscle movement I would do the same thing when typing when I was not using Dragon NaturallySpeaking. Actually, that aid that was talking about above and I figured out that saying these commands was somewhat easier when I was trying to tell her what to do when she would write for me or you been to other activities for me. Also, I showed my current PA how I use drag and a couple days ago and she laughed because she noticed that I use some of the commands in my directions that I give her when she is dressing me or helping me with other activities. Examples of the commands that I use are "go down two blank (the blank would then be the word drawers or shelves instead of the words characters paragraphs or lines)" were one that I often use almost every day numerous times a day is the command "scratch that". This command to delete the last thing that was said or done in Dragon and is a less formal version of deleting. So when I say this in every day life I will usually give the command and then say scratch that and confuse the PA. Well, this is now make me realize why I sometimes have communication difficulties with my PAs. One thing that all of my PAs, even the good ones say is difficult to do with me is sometimes understand what I am telling them to do. What they have said in the past is that the way that I talk and tell them to do things is always very formal and technical and specific which is weird for them because most of the other people that they work for a very general and do not care how things are done but just that they get done. I do not think the way I do things is necessarily bad, but I can see how this technology along with my schooling as a scientist has really influenced me in the way I do things in everyday life. That is kind of cool, and kind of nerdy but I like it. I think it would be really interesting to see in a study how technology, in this case a system technology, can influence one's life, cognition, and actions more than the intended purpose of the equipment. For example, does using a wheelchair and knowing how to navigate in a as a young child influence a person's ability to navigate themselves in an environment where all users use different equipment from what they are used to. The closest example I can think of where this would work would be when people learn how to drive a vehicle. This environment has some problems and it still because oftentimes if the user uses a wheelchair they will have to have a different mechanism to drive than the able-bodied users. Also, different mechanism may have some faults and it that could make driving harder or more risk factors that could cause accidents for the disabled user that able-bodied users may not have and the vice versa could happen. I'm trying to think of other ways different technologies or assistive technologies that I have had growing up has influenced the way you I do things in life. I'm not sure if some of things are because of the technology or if it is just because of the way I am. One thing that I'm thinking of is my ability to locate items in an environment quicker than most people. My mom always joked when I was younger that even though I could not reach anything physically or go up any stairs and due to my horrible eyesight could barely see anything that was far away that I out of every person she knew could spot and know exactly what they are

and what kind of present she bought me. This ability to find things easily I believe comes from a couple of different factors. The first factor is that nothing is ever at my eyesight so I automatically have to search for it and when searching I believe I automatically think of the biggest queues on the item that I want and look for them. The second factor, is that the items that I usually want are located where I need help and help is not always available, so when I receive help I want to make sure that I have found the correct item the first time. This is because I do not know how often and how long help is available. The third factor has more to deal with technology than the first two factors. It's is that I have grown all using many different items that perform the same action as a standard item (fork) that are completely different shaped and sized and have had to be cognitively aware of which item is mine and which one is for other people. I do not think I am explaining myself very well here. It is as if as a young kid I have been trained to think and locate abstract items. For example, in kindergarten I always had an identical chair to my peers at my table except for a red circle nonslip mats they put on my seat, so I knew that if our seating chart that changed all I had to look for was the red Circle mat and I would be good.

Dragon/word issues  
Talking for typing  
Organization of thoughts  
On screen keyboard  
Gmail  
Facebook  
Im  
Editing  
Noises

## VRS Additional Journal Entry 2

January 31, 2010,

I'm slowly starting to journal again. I have been having really good talks with Wayne about how to journal and how to put my thoughts out. It's really interesting to me that I think about journaling a lot of the time and I always find many different things that need to journal about every day. I feel like I am doing natural observations from a scientist perspective every day all day. It's so amazing what I see when it comes to the disabled community and how it interacts with the real world. Some of the biggest things I recognize comes from when I hang out with two of my good friends who also physically disabled. It really makes me think about the personal perspective you have to have when it comes to life and how to live. It also shows me a great beauty when watching each of them individually figure things out or when we interact together. I'm extremely fascinated when I see the independence and each other. Without thinking of it I know that we are independent people and that is just plainly what we have to do, but when I put on my thinking cap, which for some reason puts me in the able bodied scientist

mode with a mix of minority, I am at awe. I know I am a human factors psychologist and researcher, but my social aspects that I learned with Dr. Gooden seem to still have a huge impact on my thoughts and how I "collect" data or information. I really feel that when we are looking at the disabled human experience the social and psychological aspects of disability and human interaction appear to be overlooked. Yes, I do not think that another emphasis is made on the social aspects of disability. Sometimes, I question if this is because I am still getting "used to" my disability and becoming comfortable with it even though I have had it all my life or if it is actually the truth. From talking to Dr. Williams and looking up studies using site info and disability blogs I'm finding that it is closer to the truth than me getting "used to" my disability. Today on a disability blog I found something really interesting. It was a list of able-bodied privilege. The person that wrote it was mainly talking about chronic pain, but it was so interesting and amazing how she pointed out things that able-bodied people are privileged with that you don't even think about. It is such a great feeling to know that the thoughts that I have in the struggles that I have are similar ones the other people have too. Yes, I know a lot of my struggles do not pertain to disability at all, but ardent normal for human nature. Sometimes it is as if I want to be unique "special" different but also have some sense of normalcy. In a very elementary terminology I feel like John's series on control systems plays a huge part in all of my life and how I perceive it. In particular his ideas about every scale in any topic has not one average middle point that is normal, but one "average" area that is "normal" we are you can have a multitude of different results but all of the results work to perform the best action. I know I am not saying this correctly but this general theory speaks so much to me and how I can perceive the world. It honestly lets me embrace who I am what I am and what I can do a whole new light that personally empowers me. When I speak of embracing empowering myself it is not just in the scientific terms but by accepting who I am as an individual and how me and everybody else fit into the world in a crazy upside down inside out backwards for words wacky world.

Before I forget I'm going to write down a few general things I have learned from being with my two good friends. I told my one friend about this journal I'm writing and she said I could write about her songs that use her name and then said that she would love to have a fake name. So her fake name will be Anna. Anna has muscular dystrophy and has been a really good friend of mine since the first day of college. Our relationship is really interesting because his letters were good friends want to kill each other most of the time too. It's so funny how we compete in everything together, even though we both recognize our individual strengths, weaknesses, and the power that we have when we use them together as a team. Some of the things that I always liked chuckle about with her is the crazy but functional methods we create to get stuff done. The top things that are going through my head are when she's driving and she loses head control (very scary from my perspective), controlling the temperature in a our apartments which are supposed to be handicapped accessible but are not the easiest, unhooking my pants after a huge dinner of Indian food with scissors, butter knife's, forks, or any other pointy object that can get in a buttonhole, getting woke up in the middle of the night to take a blanket off of her and turn the heat off because the PA forgot to turn the heat down, helping each other for our courts on even though we cannot put on ourselves, and there are so many other things. I really need to elaborate on all of these but it will take many many days. I do know that I have many many days left in the program so it should be done at some point, hopefully some point soon.

The other person I'm thinking of is a guy friend who is paralyzed from the waist down of an



accident. He also has been a really good friend since freshman year of college. He can pretty much do everything on his own and go anywhere he wants so often it is him always needing to help me. However, I do find that there are things that we have to think about more when we are together. The biggest thing that we "bicker" about is who gets the extra space in the handicapped parking when we go out together. Often times the extra space is only on one side of the vehicle and we always say it on opposite sides of the car. Even if there was room in his back seat for me to sit, I could not get back there because it is only a two door car. Most of the time I just gave in and let him have the space because he is driver and leave my ass stranded in the middle of nowhere which would be totally not be cool. Thankfully he wouldn't do that, but you never know. Another time that disabilities really become apparent to me with him is when we watch a movie together on the couch. For him to get out of his chair onto the couch it is so much harder than me who just plops my butt where ever it lands. When we hang out like this, I have to step up and do most of the physical work. I do not mind it, is just different and cool.

I'm starting to get tired so I want to say a little bit about what is going on in my project before I go to sleep. Currently, I am in the middle of the second round of all the assistive technologies. I am stopped due to needing to get a copy of with it from Katherine at disability services. At this point in the game, I am getting used to drag and much more in slowly, dare I say, liking it. Had tracking and Brainfingers are working over all okay but as of right now they are extremely slow for me to type with. My biggest frustration is the slowness because my brain is going super superfast but the technology is going super super slow. I also get frustrated using -- or with Brainfingers because it is not easy to correct in the middle of a sentence that I have already wrote. I do not want to put the time and effort into the racing all that I wrote to where the correction usually made. So instead I try to make the sentence structure work with what I already wrote. Yes, I know this is pure laziness, but I know it is because if I was using my traditional stylist method I could easily and much much quicker make the change with the stylus than with using -- or. A random comment but I'm starting to appreciate the technology that I use every day. I am usually one to bitch about it and pretty much beat the shit out of it without caring but recently I have been really grateful for it. I'm grateful that I have had an amazing support system since I was little that helps me get access to the technology I need, specifically computer technology. It really says something about my parents, specifically my mom and her push to give me everything that needed or wanted to succeed in school and I'm really proud of her for that. Really proud of her, especially since she still has no clue how to use a mouse or even turn the computer on and she has had a daughter with a computer in her house since 1989. You would think that my mom would at least know that the red button is power on or power off but she's clueless but I still love her for it. My appreciation for my technology has made me want to take much better care of it. I am having a difficult time doing that because no matter what I do or how nice and gentle I am to it that seems to always be bite marks, scratches tiny bits of saliva, indentations from the stylus and many other things that form. It makes me want to give up hope that I will ever have nice-looking technology. Perhaps that is why the aesthetics of computer assistive technology for people disabilities is so boxy and so ugly, the manufacturers know it will be be up. This reminds me of my old computer that I had two years ago and my reaction when I found someone with the exact same computer but who received it two years before me. Their computer looked absolutely fantastic and brand spanking new. Mine on the other hand, was so beat up and scratched and bit that it looks like a just barely survived World War III of the computer wars. It was so pathetic. I about died of laughter and amazement when

I saw the comparison. I literally out of my head in shame. The thing is that I do not intentionally beat the crap out of my computers but it just happens. With this new one that I got two years ago within the first six hours of opening it I had already made to be bite marks and it not mean to and the original stylus that came with it was broken. The broken stylus however was not my fault, but my PA. She was playing with it and pushed a button too hard and found it funny to read the button off. Personally that his payoff

### VRS Additional Journal Entry 3

February 1, 2010,

Yes, finally the date 2010 came out the right way. Usually it comes out 2000 and. I think I had a train and 20 million times before he got it right. I'm still waiting on receiving WiViK from Katherine Myers display services. I e-mailed her today, hopefully I get it soon. I also have to say that today Dragon is working really well. I think I finally figured out a way to maximize microphone comprehension was my voice will also been really close to the microphone. Even though I have the microphone level on extremely low it usually takes up my voice to loud and the loudness disrupts what is actually being said. So what I have done is put the overall volume of all of my sound settings on the lowest at one. Actually today I also moved myself to the middle of the microphone and I am having to make the least corrections I ever had to before. I am not writing down home in corrections I am having to make because this is not a regular journal entry. But if I had to guess, today I have had to probably make only three corrections in this journal entry and probably an additional four when I was using Google chat. I should say that I usually detest using Google chat because of all of the mistakes it makes when I am making corrections. I'm still trying to get used to the verbal commands for regular desktop access using Dragon. One of my PAs that I have works for a girl that uses Dragon every single computer task and cell phone task that she needs, so I think I am going to make a meeting with her this week or next week to see how she does it. She also has a really kick ass way she drives her chair. What she does is with her only independently moving body part besides her mouth and eyes she uses her pointer finger to graze across four red, I believe LED laser buttons that move the wheelchair the way that she needs it to move. It is super sweet. It definitely is very touchy, but it is a wonderful way for her to be able to be more independent.

I am having a difficult time currently trying to remember all of the different things that I should have been writing about that has happened over the last two months with data collection. This is probably the reason why I should have been journaling every single day. Well I am definitely going to do that now. So right now I will start summarizing some of the strengths and weaknesses I have had during this data collection.

#### Strengths:

1. I have been able to embrace my nerdy side and recognize that assistive technology is a friend not an enemy. I still think that if you were to ask me right now what I thought of assistive technology from a person with a disability perspective I would say it is a pain in my ass but it can be useful and I am learning to like it. I think two months ago if you were to ask me what I thought of it I would still say it was a pain in my ass but a much larger pain than what it really is.

I just had many negative emotions and feelings when it came to having to use assistive devices and any thing else dealing with my disability or things that will help me. Some of these feelings came from not one to stick out and be different, not having patience or willing to put time into learning the technology, or extreme feelings of frustration that I had to use something that took longer to do than the average person who did not have to use it. I know that the assistive technology made things faster for me then if I did not use it, but I cannot help but compare it to what other people could do who do not use any assistive technology. I thought that is running in my mind is that perhaps when I was younger I felt like assistive technology was another factor that showed me that I was different then Mike peters and that it brought a negative connotation to my disability. One thing that I found extremely weird when I entered this program was that able-bodied people actually had an interest in using some of this technology for themselves in their personal living environment. In a way, I could not comprehend why they would want to do such a thing. Most times when I would see this in the past I would feel like people were trying to mock me and other people disabilities. I would also have questions to where they are motivation was to doing this research. Are the individuals helping out the disabled community because they were truly interested in the stuff or did they like the recognition that comes from helping people with disabilities. I'm realizing that what I am currently writing sounds extremely immature, but I know these feelings I have that to your immature are strong feelings and questions and thoughts that many people with disabilities, especially ones with congenital disabilities have in the back of their brain at one point or another. For me these feelings and thoughts are on my mind, but at an extremely low intensity. The cool thing is, is that I know that I have to have these thoughts in question people's motivations because it happens too often that people are trying to help me or are the disabled community in order to make themselves feel better and get recognition. Of course, these people will not say this out loud and if you write down what they do on paper it sounds absolutely amazing and truly unselfish, but in reality it is the complete opposite. People like this are actually oppressing people with disabilities. I must clarify that not all people are like this or have these motivations that help people disabilities, but I'm not people do that I have to be wary of it. The level of awareness that I need to have I'm realizing needs to go down, but definitely still be there at some level. Okay, I digress a little. When I met that able-bodied people that want to use this technology in their own life, I had to reconstruct my schemas about assistive technology. I finally could see the positive aspects of assistive technology. Through these people I am beginning to have a sense of value towards my technology and a sense of pride and value to myself for being able to use the technology. Yes, I definitely have found a sense of pride in this program and in assistive technology due to people like this. I am no longer ashamed of having to have special devices because in this field getting new "special" devices is a good thing and is embraced for the most part with open arms. An example of this is when my lab mates bought brand-new phones and a lot of us hovered around them and looked at all of the cool features on the phones and the different technical aspects of the phone that no one else in the general public would really talk about.

Another thing that I love and I'm proud of from doing this work is that I am able to go to places that sell technologies and ask the people questions and most of the time baffle them. I do not mean to do it on purpose, but I genuinely have questions that I do not know the answers to and would like help with. It is great being a knowledgeable and resourceful consumer. It makes me aware of many different aspects and technology and also a waiter if people are trying to scam me when I buy something. I think the best and most favorite looks I get are when people notice my

Bluetooth and start asking me questions about it and trying to sell me one that is really crappy or does not have the features I need. I've been in a professional and nice manner tell them why I selected the Bluetooth that I wanted and what features it has and how it interacts with all of the other technologies are used during the day including a computer, cell phone, iPod. The look that I see is like, "oh shit, she knows more than me. I better shut up or I will lose my job to her. She could sell these products way better than me."

2. In this project, I have also learned that I enjoy sitting up when doing my work. It sometimes feels better on my body physically and in a way I feel more focused. A big thing that I love in the physical way that I have been doing my work is that I can independently use the lap computer keyboard and mouse and view the monitors at a decent level in John's lab without feelings of frustration. I can move the keyboard level anywhere I need it by myself and see the monitors at any angle and level whether I am standing, sitting in a regular chair, or sitting in my wheelchair. This feeling is such a fulfillment for me. I also have noticed that because the desk is easy to adjust I will go into the lab a little more than usual to do regular work, because I can actually put my arms at a height closest to what I need for the maximum performance in work. It makes me feel like a little kid on Christmas or their birthday that receives a kid sized kitchen or motor vehicle made just for their body type. It is an amazing feeling and for me when I do things at this table, I feel a sense of accomplishment. I have less feelings of anxiety and stress when entering the lab using this task because I do not have to put effort into figuring out a way to make it barely functional for me and making a functional without any help. I know a big thing that would make me use the Web more would be if I could get into the lab by myself easier. Yes I can do it, but it is really a big pain, so I usually ask one of the secretaries or office assistants to help me.

3. When selecting different technologies, I need my technology to be reliable, easy to do, and to be able to be used in many different applications and environments. Like most people, I tend to not use things that are inconsistent in their performance and inconsistent in their availability. Time is important and I like everybody else would rather not waste time doing something that will unknowingly gets deleted due to accidental shutdowns or erratic malfunctions. It already takes me a long time to do things, so if I have to redo something I am conditioned to not use that product again. It is really difficult when your only choice is that product. As I said, this is not just for me and other people disabilities but I think most everybody has this feeling. However I believe people with disabilities may have larger consequences when technology is not working or malfunctions. There are also is a bigger cost

#### VRS Additional Journal Entry 4

February 2, 2010,

I still have not heard anything from Katherine from disability services, so I am doing and other journal entry. I'm hoping for this journal entry to finish what I began in the last entry and also discuss another on-screen keyboard I've found that may work. The past entry that I wrote was stopped abruptly for three reasons. 1. I was taking much longer to write what I wanted then I had given him myself time for which was okay because I was getting my thoughts down without having too many cognitive delays or frustrations. 2. Due to it taking too long, my PA showed

up to cook dinner which turned into going to Wal-Mart. 3. Even though my thoughts were coming out coherently my attention span was quickly leaving me and my performance rate was decreasing tremendously. My mind was going to ADHD to get this stuff down that I needed to write. I was going to finish the entry later on in the evening, but due to my own procrastination and crazy PA stuff going on I did not have any time until the early morning. Man, I'm really enjoying being able to use this while still moving my body around. I am extremely hyper today and I cannot sit still whatsoever. I feel like I am becoming an expert on voice-recognition because I am able to do all this moving and still have decent recognition results. I must say that I think recognition is getting better because I finally figured out way to put the microphone close to me but far enough away that it it does not pick up too much feedback noise. I also have the sound settings to me one notch on all volume settings.

### VRS Additional Journal Entry 5

February 3, 2010,

Once again, last night I got distracted and did not finish the journal entry. So I will try to finish what I started two days ago. I did not get get a response back from Katherine from disability services. I will e-mail her again tomorrow. I looked at the other on-screen keyboard and it is pretty cool except for it does not have predictive text. However, right now I think I like it and have it possibly be placed in the tablet on-screen keyboard I am using with my stylist currently. It works about the same as the current to windows XP servers package 2, but I like how it has more options in keyboard layouts that look like a regular physical hand keyboard. One thing that I loved on it was that one of the keyboard layouts had multimedia features on it. I have been frustrated for the longest time that on iTunes the only way to change songs and pause and play songs while still looking at the information using the stylus is in the upper left corner which is the farthest from me. I usually do not mind it except for when I'm getting ready for bed at night. It takes me a while to get underneath the covers by myself and adjust my pants and shirt and sometimes I get really frustrated when doing it. I had the idea a few months back that while I am doing all of the adjustments to listen to music so the music can distract my thoughts and slow down my frustration levels. This idea works great in theory, but once I got comfortable and warm I could not reach the pause button on my music. I can reach the bottom right corner of my screen without messing up my body positions but the only thing I could do there was turn off the volume. Turning off the volume would solve my problem of turning off the music, however I would not be able to get any alerts or alarms set on my computer for the next day. For the most part, I hate any and all noises on the computer, but I turn my instant messaging services and other alarms on high at night to wake me up or for my morning PA to send me any important messages that I need to wake up to. I started using instant messaging for this a few years ago when one of my roommates who was blind told us message her online if someone came or she needed to know important information when she was away from the apartment. I adapted to this theory to use with my PAs because I seem to have the luck that in the wintertime in my PAs seemed to lose their voice when they get sick and cannot call me. Some can text me, but some still do not have text messaging. For my emergency messages, I use a different screen name so I do not get interrupted by "unimportant" messages such as drunken ones from my friends. Anyway, back to the keyboard layout. The new keyboard layout has all of the buttons in any corner that I want it to be, so bottom right hand corner it is for me. Even though it is simple

simple things like location of keys and the color of the keyboard makes me extremely happy. One cool feature that was on the keyboard options was to have different skin themes and some of the themes were coordinated with different applications such as the different versions of Microsoft office and different versions of Windows. I chose the Windows 98 skin theme. Like most people, I have a set way my computer desktop and all the settings must be or I get angry at it. I've realized that I like the traditional ways I was first taught to use the computer. I remember when I got windows XP I got really pissed because the start menu was shaped little different and different colors. I am definitely a creature of habit. I also know that sometimes my habits are not always the best for high-performance, but I do not care. I like them my set way and that is all there is to it. I do change my habits every once in awhile but it is a slow process. The habits that I have really make me feel like an old person and I always chuckle and think of the saying "you can't teach an old dog new tricks." However for me, I can be taught different things, but that does not mean I will actually use what I was taught. I am extremely stubborn when I find out about new technology and new applications. I do not trust what people say when it comes to new technology and how "great" it is. Man, I feel like a grumpy, cantankerous old man. This keyboard that I am talking about I'm currently using for a 30 day trial, but it only costs \$30 and I believe I can use it on any computer. \$30 is way cheaper than what WiViK is, but it does not have the predictive text of WiViK. I think that the predictive text of WiViK is good and can help speed up typing if typing is at a slow speed, but if it is at a high speed like my stylist typing is then I think it would slow the typing process down. I think that because typing each key is such a automatic process for me that even if I became an expert at the predictive text, I would still have to scan the predicted words and find where they are on the keyboard. The time it takes to scan the words and then select the word would be longer then the time it takes to select each of the letters. If the predicted words were in a set order then it may be faster, but you do not know what order the words will come in. I will say that predictive text is nice when there is a word that you have no clue how to spell but is still a common word.

Okay I am going to finish writing about the strengths of doing this data collection that I have discovered so far. Last thing I was talking about was that I realized I need reliable, functional, and easy to use technology or I will not use it. I was discussing how people with disabilities have a larger consequence when the technology does not meet these three criteria. Also it is a bigger consequence if the technology has a minor mess up. For example, using this microphone I have issues when it is moved slightly different from what it was before. This often happens because it is currently propped up on top of books in the headboard of my bookcase bed. It is at the perfect angle and height when it is propped up on the books. A problem occurs when somebody without thinking randomly grabs a book of mine from the case or accidentally pulls the wire without me knowing it. Sends these people do not realize the purpose of the microphone and how touchy things are very more than likely do not tell me if something was changed. I cannot blame them because if I were them I would not think it would make such a big deal. However, when I start using the microphone I get really confused when it's not picking me up right and I know that my voice in how I'm talking is exactly the same as before. Now I have become quick enough to realize that the microphone was moved, so I can adjust it to where it needs to go. The problem with adjusting a use that I cannot reach in and grab it very well so I have to find utensils around the house that will move it just the right way without getting my head stuck in the bookcase.

Another thing I have realized when it comes to choosing technology is that in the future I would like something that is a cross between a cell phone and net book. An iPhone is really close to what I am looking for, but the problem is that I cannot type easily on the screen. When I use my current cell phone I used the back nail of my thumbs. Using my nail allows me to have the least body movement and the most comfortable positioning of my arms when I am sitting up or standing up. I realize that I want something like this in my I/O class with Nathan this quarter. In his class we talk about so many different things that are interesting to me and I began to have so many research ideas dealing with disabilities that I know that I cannot write them down, so I have begun to write them in my phone. I'm very thankful that Nathan has allowed me to use my phone to take notes. I know I could bring my computer to class, but it is a big pain to get it set up and put away and to use in a classroom. I like my phone because it is small and something that I always carry with me. It also gives me a sense of independence that I really enjoy. I know I could get a really small net book or something else like that, but to be honest those would still be a pain for me to carry around. Sometimes I get frustrated because I know exactly what I need and I see products that would cognitively fit all of my needs, but they do not quite fit into my physical constraints. It makes me wonder if I wasn't disabled, if I would be the type to have my laptop with me all the time or have a notebook or agenda book. I have a feeling I would be the type to have an agenda book that had space in the back for lots of notes. I say this because cognitively I really enjoy seeing handwritten information and for me writing is the easiest way for me to remember information and have the best ideas. Some people disagree with me and think that I only like hand writing things because I want to fit in with what "normal" people did when I was younger, but I know that if I need to get my ideas down the quickest and the most thorough I should write it by hand and then type it out. It does take a lot of time and effort but I really get a sense of fulfillment and comprehension when I write things out. On a different note, speaking of the iPhone reminds me of the worry that I am getting for picking out a new cell phone. I absolutely love touchscreen phones, but all of the new ones are using capacity of touch. I understand that it is best to have that kind of input for the average person which is who they are selling for, but it sucks for me. I get so excited when I see the new phones, now and I see all the features on them. I start drooling literally on the computer as I look at the different features and the new phones. Then reality sets in and I see that it is the capacity of touch and my heart drops. As much as rationality tells me why it is that kind of input my brain is screaming, "damn it! This exactly what I want everything is perfect, but this stupid interface." Then I am a little silly and start praying that for some odd reason somewhere there will be just the right phone made. Honestly not just with phones but any thing that makes my life easier I would pay so much money for it. Marketing people would get a huge profit out of me if they had more things that I could use. When I find something that I like, I will go absolutely crazy and buy multiples of that product. For example, I finally found my absolute favorite winter furry clogs in my kid size shoe after six years trying to find them. When I finally found them, I bought two pairs and am going to get three more next month. The last time I found shoes like this that had good traction on the bottom and provided good support was what I was 10 years old. So to me, a 23-year-old person wearing diligently the same shoes from over 13 years is saying something. I hate letting go of things that worked perfect for me. Another example is the Meijers brand long neon straws. When I found the straws six years ago I was so happy, I thought I was going to drive everybody else nuts with my energy. The straws were the perfect diameter around and long enough to fit in any standard drinking bottle including Sobey drinks (I also found a love for them six years ago), and they also did not lose their shape when you drank out of them. The only thing I did not like

was that they were neon colors but I do not care because functionally they were amazing. I was grateful that the colors were not the muted neon colors. I know muted neon colors seems like an oxymoron, but that really does exist. The muted neon colors gross me out and makes me feel like white trash. I was always afraid of these straws being discontinued so for the first five years I would always have a surplus of six boxes at my place just in case. Finally last year my PAs that to me to stop buying the straws and use the ones I had and I of course with my luck the damn straws were discontinued. Thankfully I stashed one extra box in the psych department that I am now using. I have stressed to all of my PAs to not throw any of the straws away unless I tell them to. Pretty much I threatened their life if they throw it away without me knowing it. Okay, I have digressed a lot about technology. So my point is that if I find the right phone that has the right applications and everything I will probably buy at least two of them and not open one until the other one is completely dead. I know that is a little obsessed of but I cannot help it. What I find something I love that makes my life better I will use it to the end.

So once again I barely got any where on the strengths and weaknesses but my brain is tired of writing. I just How much I wrote on Microsoft Word using Times new Roman font 12 and is singespaced three pages 1-inch margin. That is a lot and no wonder my brain is tired of thinking. Well, I'm heading to bed now.

#### VRS Additional Journal Entry 6

February 6, 2010,

It has been about three days since I last wrote in here. Work was not too much has been going on. We are finally getting the IRB proposal done for the NCTI project. I didn't have my meeting with Wayne this week because my PA needed to come at that time to cook me lunch since my usually PA could not make me lunch. This week we also had a huge snowstorm. All of the people who use PAs have been scrambling like crazy to try to find people that can work for them since it is difficult to drive outside. Thankfully, my PA that was scheduled for this weekend lives on campus and is not too far away from me. I have really enjoyed the snowstorm because Julie and I have been hanging out more which has made us become more independent. Sun so we cannot go out easily to get food we have been making food on our own and have been having to use our brains to figure out resourceful ways to do things. Yesterday we did a simple oven meal. Today we are making a jumbilia pasta dinner. We are both excited for it. The only difficult thing that I can come across right now is that my jaw is going to get tired from using it so much. Julia can help cook, but she really doesn't know how to cook. I am too inpatient to teach her how to do things, so I just do it all myself. I know that isn't the best thing to do, but in a weird way I'm too lazy. You would think that I would want to explain to her how to do it, but it's too frustrating when I know that I can do it faster myself.

I'm now going to start working on the weaknesses I have had during data collection.

1. As you can guess the biggest weakness has been scheduling my time with PAs. It has been very frustrating and scheduling PAs that actually do work is probably the biggest pain in my ass. I was talking to another friend who uses PAs and we decided that when people pity yaks for



needing to use PAs, they are pitching us for the wrong reasons. Asking for help from random people and needing help for the most intimate actions is completely fine and we are comfortable with it. However, dealing with the people who help us, especially ones who are trained for the job are the most frustrating parts to having help. Anyone or anything can perform actions, but actually having to deal with a PAs mood swings, attitudes, laziness, and disrespect for us as people is what makes us not want to use PAs. I know that the struggles that I have will always be in my life and how I deal with them now will help me in the future. I know in a professional job I will have to juggle PAs just as much or more than I do now with school and PAs. I have realized that as I get older I began to lose patience with the brand-new, just out of high school PAs. I know it is not their fault that I get frustrated with them because they are new to college and sometimes to work. I also know that I am not as nice and lenient to the new PAs as I used to be. I used to feel guilty that I have gotten meaner over the years, but I realized that I was almost too nice before. I would make it a priority for the PA to be comfortable and happy while I let my own needs dissipate. That works in undergrad because I had less responsibilities than. However now I am juggling too much and I cannot focus all of my attention and patients on catering to PAs. I need them to be responsible and dependable for all of my needs and wants.

2. Another weakness that I have had is being able to set up the head tracker and Brainfingers system independently. I can do the head tracker system independently, but it has been difficult in the winter because I always need someone at the end to be able to put my coat on before I go back to my apartment. Also sense the head tracker is in a lab, other people use the computer. A problem arises because sometimes people slightly move the head tracker or the desk and I will need help to adjust it back to where I need things. I do not blame the other people for adjusting things and using the computer because it is a public place and they have no idea what I am doing. This weakness shows that I must have something that is set up where I can adjust things easily on my own or a workstation that is only for me. In the head tracker workstation Clark and I also added a red toolbox as a stool underneath my feet. I like it because it is the right height and since it is heavy with tools I can use it to push against to get comfortable in the chair without worrying that it will move. In the Brainfingers system the biggest problem when it comes to independence is still putting on the headband. I can do it but if I do it myself I messed my hair up for the rest of the day. Like in the head tracker workstation, my physical settings get adjusted (headband size) due to other people using it. Once again is not the other people's fault. A way that we solved this problem is by asking and true to send more headbands that can be specific for each person using Brainfingers. I was very thankful and grateful that he obliged by this request. I also have to add that I am still in love with the desk and I am 100% sure that every time I go into the lab and see the desk I get a smile on my face. I know it is cheesy but it makes me feel so good that I can change things on my own and it can be used by all. When I crank the desk it also makes me feel strong which I also absolutely love.

3. A weakness I have had with all three different assistive technologies is using each one with a variety of different programs on the computer. Brainfingers works slow but functional and reliably with cursor control. However it is difficult to use its with Dasher on any typing applications. I definitely have to have two different monitors in order to type into another program using Dasher. When using Dasher I also have to have many repetitive extra cursor selections so that I am typing in the right text box in the program but also starting out the Dasher program. Currently, what I have to do is go to the text box that I want to type to and left click on

it. Then I have to change profiles on Brainfingers to the cursor profile and have Dasher opened in the other monitor. Then I start -- her, but the Dasher program needs to be secondary which means the window should not be highlighted. In order for the text that I type in Dasher to be put in the text box that program application I am typing in must be the main and highlighted program.

Using the head tracker cursor control is pretty easy except for when I am trying to double click items. I have a difficult time keeping the mouse still long enough for the double-click. I have changed the settings on the mouse but it hasn't helped too much. I cannot say too much about typing using with eight cents I've used it very little. The same problems arise with Dasher like it happens in Brainfingers when typing in other applications besides wordprocessing documents.

Dragon is an okay system to use. It typestyle everything really good in DragonPad, but has difficulties in almost every other program I use including whether soft word. I'm not sure why in Microsoft Word because a never used to have problems. I do find that it is pretty easy to tight and is reliable when using Google chat. I'm still having a difficult time using Dragon for cursor control and I really need to make a meeting with the other girl who uses it continuously for everything. That is on my to do list for next week. The problems that I have with Dragon and typing in other applications is that Dragon will recognize what I say and in the pop-up box it will show exactly what I said and is as reliable as it is in DragonPad. However, for some reason there is a missing link between once Dragon recognizes what I say and is in the pop-up box and the computer actually typing onto the screen in the right Xbox what I say. Another problem that Dragon has is when I am in the other programs, lately it has been gotten messenger and it definitely in Microsoft Word, it does not delete all of the words that I tell it to the Lee or the words that I have made corrections to. So what happens is that half of the words are erased and the new words or corrections are typed out. It seems like there is too much at a lab or pause in the system. While, that is all of the weaknesses that I have currently in my mind. I will continue to write about them as data collection continues.

### VRS Additional Journal Entry 7

February 8, 2010,

I finally got a response back from Katherine Myers about the WiViK program. She has the copies to it and will give it to me tomorrow so I can put it on the LWD computer. I should check if that computer has a floppy drive because the discs are 3 1/2 inch floppy disks. I just realized that discs can be spelled two different ways. This intrigues me because I am thinking about floppy disks and compact discs and they both relatively do the same thing. They both stored data on them. The compact disc can save much more so of course it can have music but the floppy disk can't. However, if you get a file small enough to fit on the floppy disk date will save it. I'm really wondering why they are spelled differently. I feel like a dork wondering lists but it really intrigues me. Okay, me being the nerd that I am had to find out why the spellings were different. So according to Wikipedia the word disk when referring to items such as floppy disks, hard drives, and RAM disks is used for magnetic recording media. The spelling of disc used in compact discs, digital video discs, transcription discs (phonograph recordings) is used for audio and video recording media. Well, I'm glad I found that out.

### VRS Additional Journal Entry 8

February 16, 2010,

Man, it took forever to write out the date today. At first the computer was reacting extremely slow to what I was saying. Then, I checked the microphone connection and realized that it was partly out. I am pretty sure that is the reason why it was not working right. Also, I have realized that when I am talking on here I usually have a quiet and monotone voice. However, today I am more energized and louder so this was creating many more errors than he usually does. I had to tone my voice down to where it feels like a whisper. This could also be because I have my headphones in my ear so I can listen to music after I am done writing this journal entry. They are currently off, but I kept them on because I cannot put them on myself. I wish there was a way that I can do that. I definitely feel like a big bad college kid when I listen to music. I know this sounds ridiculous, but it is really enjoyable and I feel good when I am able to independently and privately listen to my own music.

Yesterday while I was journaling I started using drag and for Google chat and for Facebook chat. Dragon was doing really good with writing out what I wanted, but it sucked at correcting the wrong words. He would recognize my command and would select the option I chose, but it did not come out in text output. The words that needed to be changed to not get deleted all the way so the output was a garble of mixed up letters and words. My friends noticed that my typing was different on the chat. They could not pinpoint what it was exactly what they knew it was different before he told them. I think the biggest clue is that when using drag and the words are completely and have capital letters at the beginning of sentences unlike when I am chatting. When I chat I use abbreviations and definitely do not capitalize words or letters unless I have to to get my point across.

Today, I went into the LWD lab to try to get WiViK installed. I could get the first part installed, but the word prediction did not want to work for me. I know I can ask Shruti and Ganesh for help, but I'm not sure how much they can help me. I say this only because I am following the directions exactly how it says. Katherine Myers from ODS said that a problem could be that the software I'm using is extremely old and not compatible with the operating system. I really think that this is the case. I could tell that the software was a really old because first of all it was on a floppy disk and second the Windows looked older than Windows 95. I laughed when I put it the floppy disk in because it brought back so many memories of having to deal with floppies. I had forgotten all of the strange sounds to drive makes and all of the patience you had to have to get it to work. It reminded me also of the old printers that made a ton of noise and had the edges that you had to rip off afterwards. I remember that I thought I was really high tax when I got my first printer that you do not have to rip the edges off or split the papers up. That was a great day for me.

### VRS Additional Journal Entry 9

February 23, 2010,

This past weekend was a really interesting one. A lot of my undergrad friends came back into town and we hung out. Also, my brother in law came down from Michigan to do a photo shoot of my friends and other people with disabilities and a flirty but classy manner. It was definitely a memorable time that I will never forget. Some things that I love about my undergrad friends is that they take the time to visit periodically and make sure to include me in everything. I love that. They make sure that whatever you do is semi-handicap accessible and that they will adjust things and accommodate for me whenever and wherever possible. I also love that they do not have any problem helping me with any PA stuff even though they are not getting paid. I know, it is what friends do, but it still feels kick ass.

The reason my brother in law came down was because he is starting a new photography business and needed models for photos. He had taken in photos of me before and it really was an eye opener. I know that I am "normal", but I cannot help but have the thought lingering in my head that I am also physically disabled and my body does not look right. I am continually trying to get this out of my head, but it is really hard. Some people may say that I just dwell on it too much, which is partly true. However, if you where I look and everywhere I go I see that I am not the normal human body. I'm not asking for pity or sympathy and I say this, but it is the truth. Simple things like getting clothes, shoes, backpacks, dolls to play with as a girl, all show me that I am not the normal body. Some people may think that I am being picky when I use these unimportant items as criteria to decipher normal bodies, but it is these unimportant items that can have the biggest influence. Yes, I know that not everybody fits the standardized mold of the selection these items come into, but the overall fit other people have is better than the fit that a person with a disability may have. However, the person with a disability may fit in areas that the "average" person may not fit into. And way, when I took these pictures and few weeks ago with him I was amazed with how they came out. During the photo session I had made a point to ask for pictures that show who I was and included my "disabled" body parts in a natural, beautiful, and feminine way. This request was made perfect in the pictures that he took. This event and through my many talks with Julia, we decided to have my brother-in-law come down and take pictures of other people disabilities and anyone else who wanted to and ask them their feelings and reactions after they got the picture's done. The reactions were not asked formally through a questionnaire but just plainly asking the people to write a little e-mail to me. We only had two other people with disabilities agreed to taking pictures: one being Julia and one being another senior psychology major. Truly is reaction was so beautiful, you could see it all over her face and in every movement she had in her wheelchair afterwards. Thinking about it, you could also see it in the other girls face and movements to. From the summaries that I received from them the reaction really was that day for once actually felt like a woman who buy a small but beautiful chance also had a disability. A disability personally was nonexistent from the second that they entered my apartment. They were just a unique beautiful college woman. Before doing the photo shoot, I talked to a few PAs and bribed them with a free photo shoot if they did all of our makeup, hair and PA for us that evening.

### VRS Additional Journal Entry 10

February 24th, 2010,

Okay, I want to continue on talking about the photo shoot that happened this past weekend. As I

was saying, I had a PA already for all the disabled people if they needed help foot the entire night. What was absolutely great was that the PA actually had to help everybody not just the disabled people but the able-bodied people to. There was a really funny quote that the EPA said to one of the able-bodied people there when she was doing her makeup. It was, "what the hell am I doing this for, you have arms that work! Put on your own damn mascara!" The person who was putting on makeup said, "but, my arms are crippled too, it's just invisible." This made me laugh so hard and in the end the EPA smacked the other girls ass and shoved her into the bathroom to put on her own mascara. What was really funny about this situation is that the two other girls with disabilities actually put on their mascara by themselves without being prompted to do it. And for me, I cannot put on mascara, but because of my straight but scarce eyelashes I never put it on. It is too much of a pain in the butt to do it.

The school situation was so amazing. I absolutely love that the whole atmosphere was based upon comradary between friends. We all worked together to help each other and it was just a safe peaceful, but definitely different kind of place to be that night in my apartment. There is so much more to say about this night, but I do not even know how to put it in words. The biggest thing I can think of is that that all-night I did not think at one point about the differences in my body and how it would look on the camera. What makes these nonexistent thoughts more amazing is the fact that the type of pictures we were taking, you would first think would make me more self-conscious of my body and my disability, but that was not the case. I was just me and I was with a group of my friends having fun and loving and living in the moment. That is what life should be.

On a completely different note, I am still trying to get WiViK to work on the computer. I have got help from Katherine from disability services, but it still will not work. I think the problem is that the program is so old that it does not work with the windows XP operating system. I am thinking that I should use the trial program that I found on the Internet instead. It does not have predictive text, but it should be okay. As much as I love that on-screen keyboard, I actually have not been using it that often. I sometimes forget that I have it. I also am such a creature of habit, I have issues (very little issues) with changing my routine on how to set up my computer desktop and what it should look like every time I turn on. This is a silly issue to have and I am hoping to resolve it very soon. I know how to resolve it and I know that only I can do it.

Hopefully once I get this keyboard working, I can finally finish the data collection within a week and a half. It must be done. Man, I have so much to do to get this master's project working, but I can do it. Yes, my goal is to finish data collection within a week and a half. Man, I really need to make more journal entries about technology. That is another goal I will have the next week to focus on. Some topics I want to discuss is using Brainfingers with Bluetooth headsets,

### VRS Additional Journal Entry 11

February 26, 2010,

I had my "weekly" meeting with Wayne a few days ago. We decided that since the WiViK program that I currently have is so old and is taking a lot of time to work, I will just use the on-screen keyboard that I talked about in old journal entries. Even though that on-screen keyboard

does not have predictive text, I think that if my typing speeds get fast enough the predictive text would actually slow the system now. I know that if I used predictive text with my stylus typing I would be much slower than I am now. The biggest reason would be because I would not know where to locate the words that are being predicted in the five text boxes. Also, if this other on-screen keyboard works great, it is a lot cheaper than WiViK. I'll hopefully install the program and use it tomorrow.

Since I have been doing many journal entries using Dragon I have become much more comfortable in typing. However, I still feel like my overall link which usage and format is at a lower level than when I just typed using the stylus in my mouth. I know I am still getting used to using my voice for verbal communication and for written documentation. When I am typing in these journals it feels like I am just talking to an imaginary person, which is good for journal writing but not good for formal texts. Today's journal entry is going to be much shorter than most entries. For some reason Dragon is making multiple mistakes and is highly frustrating me. I have a few ideas why this is happening. One thing I noticed is that I am having to really talk like a robot today. I am having to talk very slow and very quiet for Dragon to actually get them saying. Dragon could be also making mistakes because yesterday I talked on the phone for over four hours to various people which made my voice a little sore. Today it does not feel sore, but yesterday it was. Well, all of these mistakes are frustrating me so I'm going to get going.

## APPENDIX E

### JOURNAL ENTRIES FOR VRS AND STYLUS TYPING IN EXPERIMENTAL PART 2

#### Stylus Journal Entries

##### Stylus Journal Entry 1

October 24, 2010,

I am starting another section to my data collection. Wayne and I realized that I needed to know how many WPM I get while typing with a stylus in a journal entry, so I am doing it for at least 6 sessions. We also are adding more VRS journal entries, but this time I am not to make any corrections. We will see how this goes. I have a feeling I will have a lot to laugh about in the VRS entries trying to decipher everything. I know when Wayne first said to work with the system and not correct everything right away I chuckled a lot. It is so weird for me to try to just go with the flow of things. I'm so used to not trusting technology, people, government, and pretty much anything that has any relations to disability. I usually just listen to what's being said and then not do anything. I know that sounds awful, but for me to get anywhere in this world I learned that others/professionals usually underestimate my capabilities and limit my true abilities. So, in my head that means that I must take on the task by myself and work with anything and everything that can give me random help. I really wish that in this world I could truly trust that my best interest is truly being thought about and that I could not worry about random little things continuously. As I wrote the last sentence, I thought about the one area where I do trust people and that is my education. I trust that I'm receiving a good worthwhile education and I'm being taught everything I need/want to be taught. For me, education really is an area that is "disability free." Yes, I have difficulty with access, accomplishing things, and with my ADHD I have a truly hard time organizing my thoughts and getting them out coherently, but these things seem so little to me. I can let my mind meander, and be all that I can be when it comes to my education. I really can't imagine my life without it. It makes me think about all the people before me in the US and in Korea who were not given the ability to be educated and I'm so thankful for all of the disability education acts and laws that allow me to have these opportunities. Getting an education is truly my world and I would be lost without it. I know I'm meandering from the topic, but I'm in awe with these ideas about education. Earlier this weekend a friend of mine and I were discussing what unobtainable/dream character/thing we wanted to be as a child. She wanted to physically look like a fairy but be a princess like Princess Di. The whole time while she was going on and on about being a fairy I could not figure out what I wanted as a child. The closest remote thing I thought of was a teacher because I wanted everyone to have the ability to learn. A place where people could learn everything and anything at the person's own specific needs was my dream world growing up. So, now as an adult, I actually see my dream world slowly appearing and I'm living it. It feels really cool right now that I'm actually in the middle of my childhood dreams/fantasies. On a side note, I know my dream world is really dumb and too realistic compared to hers but I really cannot think of anything I liked/wanted that was more on the fantasy side.

Okay, back to the topic of chuckling at Wayne when he asked me to not make corrections in my journaling. This chuckling and not trusting the world I feel has been an apparent theme throughout this thesis. I for some reason have an extremely hard time with change when it comes to anything disability related. I plainly don't like it and don't trust it. I get frustrated with

using new AT because I know there are so many issues that I'll have when it messes up when I'm trying to complete a task that are harder and more frequent than if I were to complete the task my ghetto-rigged "accessible", methods that follow the same outline as the methods an able-bodied person would do. Also, I find it so interesting how I sometimes cannot let go of my own ableistic views even when I'm harming myself by having them. A better way to explain this is that sometimes when completing a task there is a much easier and quicker way for me to do something, but it will look completely different and not "normal", so instead of doing it the odd way I will adapt the "normal" way the best I can even though it is completely wrong for my body. Parts of me just cannot do the accessible way because I feel like it brings too much attention to myself, it is really strange/new to do, and/or it does not fit societies standards. A great example is eating chicken wings. I hate eating them with a passion because they are messy and difficult. I can eat them if I need to though. The way I eat them has a few top priority goals. One, I must not be messy. Two, I must not look gross/disgusting/animal like. Three, do it quick so it can be done and over with. I know that one and two are absolutely crazy to do because able bodied people get extremely messy and eat them by ripping them up like a cannibal. I just can't allow myself to do the same, even though it would make things so much easier. I could actually enjoy the meat and get it ate without getting pissed off. All I'd have to do is just put the whole wing in my mouth and bite the bones apart so I can get the meat all around and then spit out the leftovers. This sounds like a great simple thing to do, but in my head all that I can think of is all of the comments I've received about how messy I must be when I eat or how I look like a dog and I just can't get over it. Yeah the people I am with know I'm not that way and yeah I know I shouldn't let others opinions bother me, but I know that I have to fit into society as a disabled person. I acknowledge and accept that I'm going to get many stereotypes and stared at a lot just like everyone else. But the difference is that in this world these stereotypes and stares have more severe consequences than hurt feelings. They can and have for numerous reasons been ways people are discriminated against. Yes, everyone gets discriminated against a little but when the discrimination can affect your job/career, health care, etc, then it is a far more serious offense. So, if there are any possible ways that I can keep the stereotypes and stares subsided at least a little bit, then I'm going to do it. I'm not saying that I will let these things stop me from my goals, far from it, but I will try to not bring any more unneeded attention to myself. However, if the attention is required to get a point across I for sure as hell will do it.

1243 words

56 minutes

22.12 WPM

## Stylus Journal Entry 2

October 29, 2010, 10:23 AM

I'm back using my normal stylus typing today. I am still really happy about the revelation I made last time about technology and disabilities. I think that it struck me so deep because I think I struggle defining what and how much my disability makes my life different from a non-disabled person. It is such a gray line that it's easy to get lost in. As I said before, I don't really see me disability as making me that different or the accommodations I have to make until I hear/see it from other people. I know that I'm different and disabled and some things I can't do that others can do most of the time, but it isn't something I dwell on. Throughout college and



graduate school I have developed an extreme pride in my disability. I love who I am and I love that disability is a huge factor in my life. I love that I have other people who can relate to some things in my life and can just get it. I hear people discussing how important it is to have mentors in your life, especially disability related, but I have always been frustrated with the ways people perceive that mentors help a person. I always hear people talking about how these people will understand the struggles I go through or have been in a similar situation, and all I can think of is how negative it seems to connect on struggles or bad situations. My mentors/friends in my personal life that have disabilities help me with much more than helping me cope with struggles and situations. What I love most is that we do the same exact activities as everybody else in the world and the way our bodies physically do it is not really any different than anyone else, but the way we approach the activity or situation can be different from an able-bodied person. For example, we may be putting leftovers in containers and automatically we will think about what type of container is the easiest for that individual person to use independently and when it's in the refrigerator, it is placed in an easily accessible spot without anyone telling us. The type of container we use and it's placement could randomly be exactly the same for a group of people without disabilities, so as I said before the actions are exactly the same. However, the ability to know subconsciously what is best for that person, is a wonderful thing that I cherish. I agree that this doesn't happen in every situation but much more than when I'm with people without disabilities. I also love that for the most part we know and allow each other be independent without asking if we need help. I sometimes feel like it's unwritten knowledge that when we do something it may look completely stupid and messy while doing it, but that is an expectation. Also, it's nice that experimenting on how to do things on simple tasks is a daily ritual and the other person watching you isn't judging you for how it is done or the logic behind the way you do it. There is so much more to write, but something in me is getting tired. I'm not sleepy tired though. I can't tell whether it is my brain is exhausted from thinking so much or if my jaw is tired since I have been typing nonstop. I wonder if this exhaustion is the reason why I always get on the news sites or on Facebook. Yes, I know it usually is procrastination, but it is also a small break from using the stylus so much and from processing everything and trying to retain all my thoughts until I can get them all out. I have noticed today that the ratio of stored ideas and the output typed by the stylus is much higher than when using Dragon without making corrections. Dare I say, I may be losing some of my thoughts and ideas? I'm not sure, but oh well. This entry is almost over, thank God. My brain feels like squish. I can imagine it being like the Jello pudding molds that you see at parties that jiggle everywhere and if you stick your finger in it, it will pop right back up without a dent in it. It also reminds me of Marg Simpson's big column blue afro. That thing is the craziest ever, but definitely a characteristic that I don't think any 80s or 90s child/teen can ever forget. Okay, I'm done, even though I have about 10 minutes left. I'm just rambling so that words get typed out. 11:13 AM. 784 words

### Stylus Journal Entry 3

October 31, 2010 1:17 AM

I know this is a late session but I need to get these extra data sessions completed soon. Also, I do know that I often have to do my work/school work this late at night sometimes. In the past few entries in both the VRS and using the stylus I have noticed a decline in decent context formatting of the entries. In the last entry, I was having a really hard time trying to get out what I wanted to say. It somewhat made sense in my head, but by the time I spit it out through my mouth it was a

lost cause. I hope that I will be able to fix everything so it makes more sense. In the last entry, I had the topic to talk about in my head, but it just wouldn't come out correctly. I kept on beating around the bush and got lost in the details of each topic. It highly frustrated me, but I knew I had to trudge along the best that I could. My head felt like mush earlier and still does now. I seemed to get close to the topic of AT's for PWD are not marketed correctly, but never truly hit the nail in the head right on. It was as if it was a Mexican jumping bean nail. It kept on going the wrong way. This problem seems to occur to me a lot, especially in any means of communication. I wonder if having ADHD has anything to do with the problem and if so, how do you fix it? I know for myself that before I particularly pick anything to do or say, I must try to know the topic from the beginning and have an idea to the things you want. Okay, I'm not getting very far right now, but I will try to trudge through everything. Wow, I'm getting really tired and cannot last much longer. I'm realizing that when I start zoning out I'm done thinking for good. I've been trying to type on here and do it without making mistakes, but it truly is difficult. I have had to redo a few sentences because they make zero sense to comprehend and I started typing about completely random topics, just like if I had been drinking. The typing is extremely slurred and slow looking in the sentences that have my mistakes. Once I catch these mistakes, I attempt again to fix these problems from the beginning, but so many errors are continuously made through all of my text right now. I know that for my next journal session I should never do it at night because I truly look and feel like a drunk person right now, even though I haven't taken anything to drink besides water. Wow, I'm not sure what just happened but I very quickly and suddenly got an energy rush and am able to type again and actually know what I'm typing. In the past 4 sentences I think I was weaving in and out of sleep and typing at the same time. The stuff I typed before I erased it was interesting. I should say that I erased what was typed while in the process of writing, not after I moved to a new sentence. Some of the ideas were formations of odd sleep like dreams or random things that have been subconsciously had been bothering me the past few days. Man, it would be really interesting to see what I would all type in my personal journal if I had been typing in it and was still falling asleep. All I can say is that when I read it over it looked crazy and kind of funny. I just realized that today was the day of the department Halloween party and many of my other friend's Halloween parties, so my crazy entry right now would probably make people think that I'm lying about being sober especially since I said that I felt drunk and most people my age have been drinking tonight. Oh well, I know I haven't. From this crazy late night excursion of typing I have realized that I should not attempt to work when I am this tired because I have pretty much a negative production rate.

I have a few more minutes until the session is done and I wanted to mention a couple of other things that have been happening with the last few sessions. In the middle of the last VRS session, the program started responding at a much slower rate and made more mistakes than what I remember it was doing in previous sessions where I did not correct any errors. I wondered what made it change and why did it suddenly happen in the middle of a session? I have a guess that my computer may have played a part in it changing. I did notice that it started getting a lot warmer in the last part of the session. I know that sometimes regular applications start responding slower and work worse when my computer has been working hard, gets hot, and has been on for a long time. I usually keep my computer on during most of the day and attempt to give it a break at night and when I'm on campus for a long time. Otherwise, it is always running. The computer may have stopped working as proficiently in the middle of a session because it had reached its "breaking point." I should mention that I did turn the computer off for a few hours

before starting this session so it's running good again. I should also mention that the slight changes in how the computer was working I automatically got irritated and wanted to stay away from using Dragon. I was really thankful that my next session was using the stylus. I'm still slightly frustrated at Dragon even though I really shouldn't be, but I wish the next session was still with the stylus. I know that I will use Dragon because I have to and I know that my negative attitude will go away soon. I'm just pouting a little bit right now. Sometimes I wish I wasn't so immature about using any "different" technologies, because I know I'm just making life harder for myself. I really wish I knew why I did this and that I could just snap out of it. Logically I know that I need to accept change, but I really don't like doing it one bit. Okay, I should get going and go to bed since it has been officially one hour of typing. I will continue on voice tomorrow after I wake up and am semi-coherent. 2:17 AM 60 minutes

#### Stylus Journal Entry 4

October 31, 2010 4:21 PM

Man, I cannot believe this is my third entry for today. I somewhat do not count the first entry as one because I got to take a long nice break after it. Ok, that doesn't make any sense out on paper, but in my head it definitely does.

Since my last entry I have been thinking a lot about the environment I live in and what actually makes something disability friendly. Of course, areas that do not have physical barriers is one of the first things people think about when mentioning a disability friendly environment. Another aspect of a disability friendly environment is the attitudes and knowledge of others that you interact with. I have always know social interactions play a huge part in an environment, but not until I went home a few weeks ago did I realize how many little disability related things are viewed extremely normal here at Wright State or the Dayton area. An example are the different disability sports that are played in the gyms all of the time. To me wheelchair basketball, goal ball, and quad rugby are extremely normal and valid sports to play. However, when I mentioned it to my family at home they started laughing their asses off and making jokes. Even after I explained how the games were played they could not comprehend how people in wheelchairs/ who are blind play anything and it actually provide a person valid exercise. I just got so frustrated with them, but realized that it was something they would have to see for themselves. It really confused me because my family is usually extremely open about different disability activities, especially sports. They have helped me participate in horseback riding, skiing, and power soccer. On top of that many volunteer for Special Olympics. I used Special Olympics as an example to how PWD play sports and it is valid, but their reply back was, "Jenny, of course they can play. Their brains may not work right but their bodies are fine. Duh... You on the other hand have to realize some things you can do and some things you can't." In the middle of my conversation with my family, I realized that it was pointless to argue and that they may never understand. It is also really interesting how normal it is in my life to have not only my own Pa schedules to work with, but have to think about and cognitively work around so many other people's PA schedules too. I think one of my favorite entertaining parts of the disability friendly environment is all of the ridiculous petty drama that comes between all of us, especially when it pertains to romantic interests. One of my able-bodied friend's who graduated in English and has a master's in library science always joked that she needed to start writing a disabled soap opera and have it based at WSU. She called it "Days of Our Lives on Wheels" and said that she would only need to truly create a few small scenes/stories because the rest was played out by real

characters on campus every day. I told her that she didn't even know the half of it until she went down to the PA Station. Now that place is like central station for disability drama. As much as I make fun of all of the crazy drama, I really appreciate that I'm in a place that this can actually happen. It is not a weird thing, but something just natural. I also love in a backwards way that the students here can see themselves in romantic relationships whether it is with someone disabled or not. Far too many people who are disabled never ever see themselves as acceptable and loveable to another person and Wright State in an odd way shows these people that it is possible. On a different level, I am so thankful for all of my different friendships I have developed with my fellow peers with disabilities. I truly think that we have been able to learn so much from each other. I know that they have helped guide me to become confident in who I am as a person and a person with a disability. I think that because there are so many strong people on campus with disabilities there is a higher acceptance throughout the whole campus towards disabilities. Even the most absent minded, non observant person on campus would have to somewhat recognize that there are quite a few people on campus with disabilities and that we are taken in consideration during programming and basic development that occur on campus. I think that one of my favorite services that Wright State now offers that truly resulted from us students with disabilities is the magic bus on the weekends for residence halls. My friends and I went up to the then honor's government president who became resident senator the next year and told them that we need an accessible shuttle that can take us off campus on the weekends. This idea would not only benefit the students with disabilities but many other students who did not have a vehicle to get off campus. This whole idea truly stemmed from the winter formal of 2005 at the Holiday Inn where a shuttle went to all of the resident halls to pick up students but was not accessible for wheelchairs. My RA was PISSED and made a point that it needed to be accessible by going to the Holiday Inn in her chair and calling the on campus police when she got stuck in the knee high snow. The whole problem could have been avoided if they had not discriminated against part of their student population and had an accessible shuttle. I also went to that formal dance with Anna but we did not walk/roll there. One of the other students on the floor had an accessible van and let our PA borrow it to drive us there. Man, those were some fun times back then. I know I would never have many experiences like this if I had not come to Wright State. I think that going to Wright State for school instead of other schools has made me more confident to assert what is a right of mine. Often people think that WSU teaches assertiveness through skill set lessons that ODS teaches the incoming students, but I think it is much more than that. I think the reason why it has made me more assertive is because us students with disabilities are accepted as a valid and important part to the Wright State community. I know that if I have a complaint or am discriminated against that I'm not the only one. If I talk to other students with disabilities, I am positive that I will get feedback and strong reactions from them, which adds strength to the complaint using population size as a power. I know that because our population is so big that we cannot be ignored. I am starting to realize that a good thing about Wright State is that I'm oppressed less than I am in other environments. However, just like all living experiences WSU still has strong areas where oppression and discrimination occurs, but it is something that needs to be continuously evolving and worked on in all schools.

5:19 PM

### Stylus Journal Entry 5

November 2, 2010 11:36 AM

I have been thinking a lot lately about how I got into doing research, science, and mentoring and how my disability has influenced my decisions. I have to say that if anything, my disability is a strong cause to why I am here right now. I always had a love for science growing up, so it was obvious that I would be in some type of science field. I also was continuously asking a million questions about how things work and why they work the way they do. I'm not sure if asking the millions of questions was because I was a curious kid or if it was because I was always trying to find things that I could do to make the way I live better. It probably is a combination of the two. I recall always grumbling about how I couldn't do everything the "typical" able-bodied way. I always was upset because it wasn't fair and that I didn't think anybody was able to help me. I also remember in these funks that I'd have that I had this internal drive and creativity that said that if no one was going to help me, then I was going to invent ways I could do it. Even if my ways were never ever going to be able to work, it at least helped me pass my time while I sat by myself while others went off and played. During these thinking times, I had to do something because I was often stuck outside sitting in a pile of dirt or left downstairs with an annoying VCR that's movie just ended. It would start off with my siblings/nephews being with me, but they were able to physically leave when they were done. Then I'd be stuck wherever I am waiting until an adult remembered me and could pick me up. I would tell the other kids to get someone and I would scream for help, but often no one could hear me. So, the next best thing to do was try to keep myself entertained without toys and annoying things going on in the background while I waited. I think one of the ideas I had during these periods was a way for me to get up the stairs by myself. I'm pretty sure I figured out two different ways. The first way was more or less crawling backwards up the stairs using my elbows, head, and feet. The second way was going sideways up the stairs using my head, neck, and legs. I preferred the backwards crawl, but as I got bigger, I couldn't do it anymore. My elbows were not long enough to use as a crutch in comparison to my torso length and stair height.

My disability also affected where I am today because I knew from the beginning of time that I would have limited work choices and limited ways I could survive independently. I knew as a small child that I always needed help with daily activities and that my body limited me, which meant that I could not get a job at a place like McDonalds in case of a job crisis emergency. Honestly, back then I thought McDonald's was the best place to get a job and what made me realize I couldn't work there was that I was too short. It never dawned on me that I couldn't use my mouth to cook or that my hands wouldn't work. It really was just that I was extremely short even in my age group and for a workstation to be my hand height; I wouldn't be able to ever find one. I find that extremely interesting that back then the parts that triggered about my disability not allowing me to do things was not the biggest limitations I have (arm use), but that my height affected it. I knew that I would grow and that adults were a variety of heights, but I just knew that my disability would cause me to be in the extremely rare short height and would cause problems. Since McDonald's was out of the picture as a job I went with what I loved the most, which was learning, thinking, and school. I never ever saw any obstacle in school that pertained to my disability. Yes, I had an aide with me, but she was there to only help me in the bathroom and play outside. She did help me in the classroom as I grew older to write and take notes, but that is all. I really never saw myself as different when I was growing up until the adults in my life pointed it out to me and put limitations on me by making me use stupid resources that they provided. This can do attitude and seeing myself the same as any other student has stayed with me all of my life, so going to college, grad school, etc was always a part of the picture.

What was not always a part of the picture was doing research. Like most kids/teens I really did not know what I wanted to do for a major in college or what kind of job I wanted. I still thought that I could do any major and job besides play a musical instrument without my disability limiting me. I didn't truly know that other people with disabilities had a different attitude and that a lot of us chose majors based on what our disabilities limited us to do. I truly assumed that the majors we picked was because it fit our overall personality and life goals, just like how I picked mine. I never really knew that people with disabilities were relatively rare in the STEM fields because of the social limitations and opportunities. I knew there were not many in the fields, but I just assumed that it was because STEM related field people were rare to come by in general and since PWD are a relatively small population on college campuses there obviously would be less of us in general. I know now how backwards my thinking was, but it is truly what I thought. When it finally did come to my attention that PWD in STEM fields was rare due to other reasons and a huge push was starting to get us into the fields I was geeked. I thought that finally I'm in the right place at the right time. I could do what I love and plan on doing no matter if this push existed, get funding, make great networking connections, learn more about disability, and actually get to do cool stuff because of innate unchangeable characteristics of mine (disability). What more can I want? It was the strangest thing for me to be a part of program or initiative because of a quality that has always caused me difficulties. I definitely in the beginning was extremely suspicious and wondered what the gimme was. I also thought it was extremely weird that a disability would actually help me earn money and a job. 12:36 PM

### Stylus Journal Entry 6

November 5, 2010 3:33 PM

So many different little things pertaining to disability has been going on lately. I am so happy I'm in the position that I'm in right now. Yesterday I went to a meeting to talk about accessories that I'd like on my wheelchair and it was so great. I really didn't want to go to the meeting at first, but since I got two emails about it I decided to get my butt up and go. What I loved about it was that the people who came were truly interested in what we wanted and what was helpful for the user experience. I loved that some of the simple things like trays that moved easily, places to put your personal supplies, etc were viewed as important and a necessity. For me and the rest of the students there these things are obvious and extremely simple things that we want to have come standard on our chair. I still cannot get over how nice the people were and how they actually listened to us. I still have hesitations that our wishes will actually come true, but I can only pray that they will. I wish that I didn't have to always second guess if I will get the things I'm told I'll receive. I know everyone has to do this every once in awhile in their life, but I think that when you are disabled, it effects you much deeper and more personal than if you are not disabled. Even though I don't see myself as a full wheelchair user, I still rely heavily on it and if I don't have one when I need it, it affects my mood and plans for the day. I have to ration out where I will walk by how important it is and the duration of the walk. In addition, I have to add my recovery period that I'll need for that day or days.

The last few entries have been about how much disability has affected where I am in life and I'd like to continue talking about that. I cannot say that I would not be going to grad school or doing research if I wasn't disabled, but I am not sure if I'd be in this program or having this many opportunities to do all the things I do. I think about how I started college and how somehow everything I decided to do was based on or caused by something disability related. As I said

before, I knew I had to go to college because my disability didn't allow me to do hands on jobs. I also know that on top of going to college, I had to do really well in school and work hard because academia was the only way I'd receive any kind of scholarship. I sure as hell wasn't going to get money because of sports and there were already so many Asians doing well in college any scholarships would be gone pertaining to my Asian American identity. I did not expect BVR or anything like that to pay for it because you never know when they will take away what they give you. Yes, there are scholarships for people with disabilities, but so often they have requirements that often pick specific types of disabilities. Because Arthrogryposis is so uncommon and because there is not a lot of support for the group, I never fit into a scholarship category. Disability also lead me to doing research. If it wasn't for programs like STREAMS and my motivation to use all of the opportunities in front of me, I wouldn't have received the experience I have now. I had an idea that I would liked research, but never thought I could do it for other reasons. I was afraid of speaking in public and afraid that I was too stupid to actually do it on my own. I couldn't imagine myself actually being able to present big things or talk loudly to many people, but the first time I was put in front of a crowd to talk about stuff I have studied I was a diva, lol. It's as if I'm on fire and a camera is rolling every shot. Yes, I get nervous and go crazy beforehand, but I feel so comfortable in that environment. The STREAMS poster presentation the first year truly showed me that I was capable of doing all of this work and that my disability did nothing or improved my performance. I was Jenny the researcher, not Jenny who walks like a penguin and moves her arms like a dinosaur. I really am king of the mountain when I am doing research.

Being in the HF psychology program is completely because I am disabled. No, it isn't because someone chose me due to my disability, but I was first introduced to it through a pre college event for high school students with disabilities that I was being a student mentor/leader. I never would have been interested in HF if I hadn't gone to John's lab and tried Brainfingers. I also would have never fully known what HF was all about. I took my undergrad psychology classes here at WSU, but could never really tell you what our grad programs really did and why I should be interested in them. So, when I learned all about the grad program on this little day event, I was mesmerized and wanted to know much more about it. What the coolest thing was that I found out how much HF played such a huge role in my life. Knowing what I know now about HF and I/O I can appreciate and understand my life and other people with and without disabilities life's so much better than ever before. 4:24 PM

## VRS Journal Entries

### VRS Journal Entry 1

Over 26, 2000 11:50 PM

This is my first entry using voice without making any corrections. Already it is really weird for me to do it. I want to say right now that the time is not that whatsoever, while the time should say is to 12 PM. Well, it still wasn't right but it least it makes sense now. I'm really not sure what to write today about the different technologies. Nothing has really come into my head so a lot of blank time is being taken up currently. Okay, let me start rambling about different technologies.

I have to say that I actually set up my computer a little bit different today than I usually do. The microphone is in the same spot and I still have the computer in the same spot. However, I just added a lap desks cooling fan which adds about 1 to 3 inches of height. The ID is angled so the bottom of the computer is at 1 inch and the top of the computer is at 3 inches higher than usual. I am hoping that this fan will help my computer stay cool. I have to say that balancing the computer on top of the lap desk thing is better than what I had before because it evens out the weight placement of the computer and I am able to move things much easier than before. Oh, I have to add that Dragon told me there was a update for the system so I updated it from the last time I used it. I think it has affected the performance a little bit and definitely for the better.

Lately, I have been seriously looking at different computer systems that I may want to buy for when I need something extremely portable and something for desktop use. I can't remember what the company's name is, but there is this new little PDA like saying that is only a 4 inch touchscreen that allows me to do all of the things I wanted to do. What is also great is that it is only \$100. They also have more products that are bigger in size, but also cost more too. I really would like something like this for when I am taking notes in class or in meetings and when I am traveling places and have free time. I really wish I could see one in person before I actually buy one. The other computer system down looking at is a big desktop monitor computer, similar to what Apple has. Apple is actually one of the computers that I am looking at. I just read what I said and I find it really funny that I still call max apples even though they have not used the company name Apple in a long time. It just goes to show that you cannot teach an old dog new tricks. Like I said in my last entry, I feel extremely old and I think I ask old when it comes to anything this ability related, especially technology. I still find it really strange that I consider myself old and especially related to the relationship between technology and disability. You would think that disability and technology would be something that I would see as always changing and always knew. But then I start thinking about the technology that is offered to people with disabilities and I really see that it hasn't changed much when it comes to helping us use technology made for able-bodied people. I think that the biggest thing that has changed now our programs and equipment like Brainfingers and Dragon. Dragon definitely has changed and become a lot better over the past 10 years, but I still think it has a lot more more to go. Brainfingers, obviously is a newer technology and has way more to go before it can be adapted for everyday use for everybody, not just gamers and people disabilities. It will be really exciting when systems like Brainfingers will actually be functionally usable for the larger population. You know, I'm thinking about other technologies and some things have changed for the better. I just thought about why gays and the technologies used for the blind and deaf. They are pretty



sweet, but I wonder what the end users think about the new technologies and how they are compared to the old ones. Right now I'm chuckling in my head about how rehab people still tried to get me to do my typing with a big long stylus/mouse stick while I am sitting up. I understand it is pretty much what I do on my tablet PC, but you would think by now that they would make a mouse stick better for what each individual's mouth. The stick looks so ugly and dumb. Also, it is so hard to fit in your mouth, especially if you don't want to drool. Honestly, I have used that stupid mouse stick about 15 times because I was forced to in high school. Now, I do use a steak daily but definitely not for typing. It is my favorite tool to use to change the key in air in my apartment, grab things from up high and get stuff out of the freezer. It definitely is my version of a grabber. I would love if they actually could make a mouse stick that was a grabber. It would definitely have to be sensitive and meticulous to make and use but it would be worth it. It would make life so much better if I had a mouth grabber. Oh yeah, I also use it to open and shut my Windows.

I still am having a really hard time getting a lot ridden down. My brain is just not thinking about writing anything that is relevant to this topic. Anyway, I have been thinking about recently how I am going to integrate using ever technology I choose into my everyday life as my regular use technology. It is still really hard for me to switch over from the stylus to anything else. I am starting to realize that the stylus is a little slow for me, but I'm just so used to it. I don't know why, but I do not want to change even though I know I really need to. For a little bit in the summer I thought that I didn't need to change systems as much as I really do because my body was hurting US. However with the fall approaching end with all of the increase in work that I'm doing I can tell my body is falling behind. I absolutely hate this old person feeling that is in my body right now. I know I shouldn't say that I feel old when I'm only 24, but I swear it is the same feeling old people get. My muscles, bones, joints all eight and are so large it. It is really frustrating, because my brain may be completely wired and ready to do things, but my body just lags behind. Since I have been working on my thesis more and having my class, I have noticed that my left arm is getting more messed up using the computer. I will admit that I forget to use any of the assistive technology devices in use by stylus point of still. There were a few nights that I actually couldn't sleep because of the pain and I even took a pain medicine. I don't know why, but today he Dragon seems to be doing a lot better than what I am used to it doing. It can seem that way because I am not taking the time to make the corrections so I am ignoring everything that the dialog box is saying except for if it has the?'s that mean it has no clue what I'm saying. Yes, I think I am actually getting a lot more out of my head than expected because I am not making the corrections. I'm just zoning out and talking. I wonder if I will actually be able to do this if I write a document that is needed for others to understand and use. For example, for my thesis would I be able to actually write out my ideas in a coherent and professional manner and not go crazy because I'm not making the corrections. I wonder if I can do it not going crazy because when I type I often reread the last few words that I wrote over and over and over again because I lose my ideas so quickly from my head. Perhaps, because I am doing it without making corrections and just going with what goes on the top my head I can get things out better. I really am concerned though about me being professional and articulate myself correctly. I truly have a difficult time writing professionally and articulating myself clear and concise. That reminds me, Britney from Wallace A. was telling me how she had to help transcribe some things I said in a nephew and she told me that it is very difficult to transcribe my words because it looks like ADHD on paper. She said I was all over the place with multiple topics, or will grammar and

punctuation, and would never finish sentences or ideas. I just laughed because I was so happy someone else realized how retarded increasing my brain sometimes works. It is so frustrating trying to get everything out because I know I sound like I'm a dumb ass when I talk sometimes, even though I really know what I'm talking about and I really am smart about certain topics. But wonder if there aren't any resources or support that could help me with this problem. I know to go to OES, but for some reason I just don't feel like it. It's one of those things where I don't know how they can help me. I know a lot of things that I can do is organize myself and my thoughts through management techniques, outlining, other things of that nature. I also know that I am really good at structuring items. I guess the best thing that someone could help me with is helping me make decisions on what topics in a document or task is most important to do. In my mind I see anything am trying to do like a path analysis. I see a variety of different variables that all effect each other in some way. Some cause others while others are just correlated with another bearable. Also sometimes, the variables that are in my head are so closely related that I can't tell whether they are individual variables or if they're the same. I wish sometimes that I could use M. plus as my analyzer for all the thoughts and ideas in my head. Man, it'd be so cool to map everything out and have actual statistics backing up what I am trying to say. Man, I'm such a nerd by really love this idea. Yes, I wish I could analyze and make my life all into statistical and mathematical in equations or analyses. Oddly, it seems like it would be much easier than the crazy methods used now. I wonder how many other people would agree with me on this statement. I would find it really interesting if we had a variety of people's path analyses or even one person's path analysis every day. You'd be so intriguing trying to figure out what was significant for each person and what was significant for them over and ask. If time.

I know that this journal entry is very scatterbrained and has multiple topics that jump from each other randomly, but it is all I can think of to fill up the link time in the session. I do not know why I am having such a hard time thinking of everything to say today because all of the other journal entries I never had this difficult problem. The only thing I can think of is that because I'm not making corrections that have so much more time to write everything in my mind. Perhaps, I am just not used to being able to get everything out so quickly. It is really strange but I kind of like it. However, I definitely am not looking forward to all the corrections I would have to make if I were to make the corrections. That would suck really bad. Another thing that I noticed that isn't happening using the system with this new update is that Dragon is actually typing out everything that is in the dialog box that is supposed to type out. That little change makes using the system so much better.

3:04 PM

## VRS Journal Entry 2

The presentation of assistive technology  
the decision to use assistive technology  
reducing the negative views of assistive technology

October 28, 2010 11:27 AM

- For this entry I decided to write a list of things that I want to talk about. I'm not sure it's

it is just me and my stubborn ways but one of the hardest things while during this project was getting over my personal views of assistive technology. I know I have mentioned it quite a bit, but it really is a struggle sometimes. I find it really silly that I see as a struggle and that I rejected so much. Part of me realizes I am ridiculous in rejecting it and that I can see the confused and puzzled looks on everybody else's faces when I say how much I hate it, which highly embarrasses me. I wish I could be more open to it. Obviously, I am getting more open, but it is it wasn't for this project and for other disability related events on campus I would say screw this and not even mess with the technology for myself. Yes, I have always agreed and M. adamant about using the assistive technology that works best for you, but I have these very sour attitude about technology of her being really good. Man, all I can think of is the grumpy old men attitude whenever I think about my attitude towards technology and disabilities. I thought about possible factors that may have influenced my views of assistive technology that has not talked about before. One factor could be that using assistive technology was more of a demand than a decision given by adults and people in rehabilitation. A sub factor with this "demand" could be that I was extremely young when I was introduced to technology and it was not introduced in a way that I truly understood and could agree on why it was needed. When I was first introduced assistive technology all I can remember our old people that really did understand the technology but was crazy for it sitting or standing around me telling me it's the best thing on earth for me to survive independently and productively. I know I mentioned a scenario like this before, but it it really is the base of my dislike for its technology. Yes, I wanted to "survive" independently and productively as a member of society, but I never got why did I have to have this stupid stuff. Yeah, I agreed that he was kind of cool, but it it also seemed like a really of doing things. I should say that at this time, probably around eight years old, computers were still a new super fancy thing that only professionals and really smart people actually dealt with on a day-to-day basis. It was definitely not the norm or as significant to a person's life as it is now. I didn't get why writing using paper and pencil was such a bad idea. It always works and when it didn't there were always ways to work around it. If your pencil broke you could sharpen again or you could just buy another pencil. That seemed financially way cheaper and much quicker to do then learn that stupid computer. I also understood that the computers could get better and evolved into something great, but why did I., a elementary student have to use the stupid thing. I knew I obviously wasn't smart enough to actually get the full use out of it since I could barely read, so I didn't understand the purpose. Obviously now I understand the purpose was to help me keep up with the other students in class because I couldn't write very well or as quick as them. However, back then I only recognized that I had a little bit of a problem with the writing but still thought I was in the normal continuum of the whole class of students. It's funny, but when it came to education I never saw myself as different, so I did understand why I needed to use different things. Yes, I knew that I could use my hands very well and that I couldn't walk very well, but that is why I had an aide in a wheelchair. I did recognize that it was difficult for me to write and I took a much longer time than everybody else, but I had stored this as a fact of my life. I just assumed that everything would take longer and would be more difficult than everybody else. Yeah, it sucked, but it that was life. Deal with what you have and get over it was my attitude. Yes, now that I'm thinking about it I really did not get why people push technology on me so much. I am also

extremely intrigued about how he viewed my disability in life and especially in school. It was a really weird and confused combination of identities. Have no clue how I identified myself back then but I would be really intrigued to know if I even identified myself as anything pertaining to disability and if it changed a lot. A big part of me thinks that as a kid I took my disability as just a difference just like how some people have red hair and some have blonde, but I never really thought about it pertaining to ability. I lived in my fantasy world where I can do everything that everybody else did; nothing personally or physically limited me. I think I started learning that disability could be a limiting factor in life because of all of the higher up people making such a big deal about how I had to do all of these "different" activities to help me survive with a disability. In my head back then I thought, "well, duh, if you make me do all of these "different" activities, of course I'm going to have a more difficult time in life. You are making me do everything a backwards way so on top of actually having to complete whatever thing I need to complete I'm having to do it this new way. Now the task that I am having to do is twice as hard so of course it's twice as hard, then it will be twice as difficult to keep up with the other students and in general and life." On a random know this topic makes me want to do research on the formation of a disability identity in children. As I read what I just wrote about what I thought as a child I chuckle to myself. I can now see and appreciate why the adults pushed assistive technology on me, but I equally see and agree with what the child in me thought of assistive technology. I find it funny that even though I appreciate the adults point of view much more now, I still lean to the child's side of assistive technology even though I know that it is semi-faulty thinking and should not be used as a factor in deciding to use assistive technology. I really wish that I knew or research could find a way to develop a connecting link that would enable children and the little child voice still inside me to understand in a positive way that even though using certain technologies is helpful and may seem like it makes us more different than what we physically already are, but we are still the same and just as capable as any of the other kids that surround us. That connecting link is a link that I have found a few times, but struggle quite a bit to retain in many different areas of my life. I feel so childish saying all of these things because part of me feels like I should be completely over this issue and have moved on to so many more important and more difficult things. My mind is numb and awestruck right now with this revelation. All I can think is, wow this last few ideas pretty much sums up all or almost all of the gravy feelings I have always had about my disability. It's only been 15 minutes in this journal entry and I have so much more to write about, but it I need to think about this for a while. 12:19 PM

### VRS Journal Entry 3

October 30, 2010 12:09 PM

Another factor that could play and people actually using this technology is how it is presented overall. To be honest, the assistive technology that we are given looks really old and crappy. A lot of the time the ox is that it comes then looks like it came from somebody's basement that stuck in the 1970s. I know the physical presentation should not make a big deal, but as we all know and marketing it does. Also, the technology really has not grasped much since the 1970s. Yes, of course there are some things that have changed but overall the technology we are given

our just aides that help us to activities as if we were able body. I really wish the marketing of the assistive technology was better and more global. It would be really nice to see in the disability magazines, brochures, and other rehab places have pictures of people from the current generation actually using the technology in modern clothing and activities. It would also be nice to see people that are not just the elderly. Seriously, what teenager will want to use the same product that is marketed to the bald guy with no teeth and that has no clue how to use a computer. Also, the product that is marketed to the bald guy may also only be truly functional for that group of people. If those type of people don't know how to use computers there will, then some of the functions of the technology may not work for the people, in this case younger generations, that need or want to work with higher computer functions than the Internet, e-mail, word processing. Also, it would be nice if the technology itself physically was more attractive. It would be nice if things like mouse sticks had different skins that you could lay over it. Or would be nice if we could have cool looking mouse grips that did not look like it just came from the hospital wing. Who really wants to go around using something that looks like it came from the hospital? Yes, I think it would be really really sweet if I could have a mouth stick that had a different type of mouse grip that's what sense the nasty clearer, turning yellow with saliva caller. You look so dirty and in essence makes me feel embarrassed and dirty if other people see it. Yes, I really feel retarded when others see the grips on the mouth stick. Also, I could imagine using a magnetic skin on the long stick part, just like how people do that on their laptops. That would be so sweet. I would also love to have things customizable. I'm thinking about my mouth stick and I would love if I had different tips on. I wouldn't have one tip to be able to turn things with an edge, a rubber tip, a suction tip, and a grabbing tip. That would make life so amazingly independent. I think I would just start drooling looking at the mouth stick with all those different sets. Sometimes, I wish I could go into the history files of certain assistive technologies and see how they were developed and see really how much thought was put into it. Sometimes, I think that not a lot of thought was put into it. I know for technologies like Dragon, I tracking, and BCI's there are a lot more talks put into making the product, but what about products like grabbers, and mouth sticks. You know that there has to be more ways to make these products better for the consumer than what is already out there. A good example of this are the many types of mice and trackballs out. Everyone knows what the basic mouse and trackball looks like, but now there are so many different shapes, sizes, styles, and formation that are out there and seemed so customized for multiple people. I know for myself that I get frustrated with a lot of the new trackballs out because many of them I am not able to use because of their shape. I know a perfect trackball for me would be truly simple to make if somebody could do it. Pretty much it would be where the ball would be in the front and the mouse buttons would be behind it and a scrollbar in between the two. Also the trackball would be extremely small so I could just use a little piece my skin on my face to turn it or use my finger. It would be amazing if it was wireless to.

I have mentioned some of the marketing that people use for assistive technology and people with disabilities, but I'm intrigued by the overall marketing of any product or service for people to disabilities. Why do most products and services have to be so crappy looking? As I said before, most things look like they are decades old and only old people are on the products. Even when there are people who are younger being advertised you can still see that it is old because of the hairstyle, clothes, technology devices (wheelchairs, canes, walkers, leg braces, hearing aids) they are on the people. Also, it seems that the people in the advertisements are so stereotypical. The disabilities that they show are usually people who are paralyzed after birth, cerebral palsy, spina

bifida, and muscular dystrophy. Yes, this seems like a variety of physical disabilities, but when you look at the ad you can see that three stereotypes or per trade. The first stereotype comes from cerebral palsy. This stereotype usually has people looking awkward and in the middle of having a spasm, which makes the person look mentally retarded and not independence. The products that this stereotype usually markets are sensorimotor AIDS and other childlike toys and gadgets that do not need a lot of brain capacity to use it. You often do not see people with cerebral palsy advertising products and services for a professional who may need them who also happens to have a disability. The next era type is the Penny stereotype usually used with people who have muscular dystrophy and sometimes spina bifida. Marketers usually used children are teenagers to sell the products and services. This stereotype usually exhibits pay me and pulls at the marketing person's heart. It usually has a queue little kid doing kid like activities with big brown eyes and a great big smile on their face. The last stereotype, besides the elderly stereotype is where marketers use people disabilities in their shots, but they look completely able-bodied. The people usually used or per trade in the stereotype are people who are of been paralyzed after birth. A lot of the time and D's marketing activities the person is in a really crappy medical wheelchair that no one in their right mind with a real disability would ever use. I don't mind using people who are paralyzed and seem otherwise able-bodied, but marketing they uses these people every single time no matter what really isn't helping out the overall disability community. Promoting a product for people disabilities should include all varieties of people who will actually be using the product. Oh, I should mention that the able-bodied and disabled people stereotype also usually promote most of the professional, educational, and adult like products and services. These people are also often and manual wheelchairs. If they are ever in a power wheelchair it would be a crappy jazzy like chair that you see I'm in for marshals on cable. Jazzy chairs are also chairs that anyone who has a lifelong disability and is active would never ever use unless it was for tearing apart and killing when they are angry.

I have to say that one wheelchair company actually has an amazing marketing team that uses real-life events and experiences with people who look like they have real disabilities and are living life to the fullest. This company is of course my favorite per mobile. My favorite ad that I have seen is the one where a dad has elevated and stood up his chair to a urinal next to his little boy who was also going to the bathroom. That is such a strong sense of manly hugs and also independents all still been in a wheelchair. Another ad that per mobile has made is a young guy in college running from what looks like a fraternity party without any pants on with his friends. I should make the disclaimer that when I say he was running what I meant was that running is synonymous to rolling fast in his wheelchair. I can definitely see many many people here on Wright State's campus doing this and many other crazy things. Oh before I forget one of the last two@remember are ones where a group of friends are out at the bar and their wheelchair is elevated high so they could be a high level with their able-bodied friends. The last ad that I remember is of this girl out on a mountain doing yoga positions while in her wheelchair. I could totally see some of my friends doing that to. I just love how all of these different activities that per mobile expressed are ones that I see at least a ready state every day. I also like how per mobile has set up its website for the consumers that actually use the products. They have a great pool that allows you to do the general identity of your disability and how it affects you and return it provides the type of wheelchairs that are good for you, your size, durability level, and your type of disability. I was really excited because they actually had my disability in one of the general topics. It is also nice that it allows you to see what type of wheelchairs are good for people with varying weights. I like this feature because I require a wheelchair that performs the

needs of an adult, by because I am a small adult I can also get features on certain chairs that are made for kids and that are helpful for me. For example, one type of chair that I can get because I'm under 125 pounds is a chair that elevates and lowers all the way to the ground. A chair that lowers all the way to the ground is extremely helpful and makes me feel more secure for times when I am alone on the floor and need help getting up to a sitting and standing position. Chairs can only lower to the ground for people under 125 pounds currently in the United States because safety regulations think that people above that way may tip the back the chair over if the fine is lowered at such an angle. Man, I just left her mobile and everything about it. I could go on for days, weeks, months, years on my love for it. Perhaps one day I'll write a letter to them telling them how much of a lover I M. of their products and a forever consumer. I think that even its I couldn't get insurance to pay for my wheelchair I would rather buy one out-of-pocket than use anything else that insurance made by me. I almost want to say that I would sacrifice having BVR paid for the adaptations to him might knew vehicle for a per mobile wheelchair, but that is only if I Have to. Otherwise I really really would like to be independent and drive on my own. One: oh 1 PM

#### VRS Journal Entry 4

October 31, 2010 to 20 2 PM,

I am finally awake and ready to go since last night's crazy entry. I don't think I will ever be doing a late night entry again. I didn't look at the words per minute in the last entry and realized that it actually wasn't the lowest words per minute using the stylus. It never dawned to me how slow my typing sometimes is when I am using a stylus because of all of the thoughts that I have in my head. Today while I was setting up the system I realized that another possibility to why more errors are occurring is that because I am not correcting the errors Dragon is changing my settings after each use. Dragon always changes the settings after each use because it is a default task and for the most part it is the right task to do. It does this because it changes its vocab very and its ability to understand what it is exactly being transcribed by the user and it usually uses the corrected errors as ways to make its transcription better. However it is not able to do this with the last few entries because I'm not correcting any of the errors which results in Dragon thinking that is not making any errors then the words that it gets wrong dragon things is exactly what I had said. I'm not sure what to do about it, but I have changed the default setting to where it does not change my user files anymore. Hopefully, it gets better or at least Dragon understands my words the same and not any worse. I realize that I already am adapting my voice to Dragon not working correctly by articulating my words and expressing myself in a more clear and loud way. It does make a difference on how many errors Dragon makes. Well, I at least think it makes a difference. It would be interesting to see if there really is a difference at all or if it is just my imagination. I wish that there was a way for me to see why it exactly Dragon changed my settings after each session that I have completed that did not include any corrections to errors. I am thinking about how we said it may be easier and better if I did not correct any of the errors and after a while I started to believe that this was true. Now, I am not sure if it's the best idea because of the errors that I think it is making on top of the ones before. I would think that Dragon would continue to make more errors and that the productivity rate would decrease. I wonder what the learning curve is for Dragon to decrease the number of errors it makes while trying to comprehend my voice. I would think that the learning curve is defined with each individual, especially after the individual has a speech impediment. I should also mention that

since the last voice entry dragon is responding much quicker and it's not frustrating me as much. Yes, it is still frustrating me because of the number of errors, but I am overall okay with it. Another small frustration that I get is using Dragon is that because I seem to go so fast and a lot of text gets written down quickly I get lost in what is all being discussed. For example, right now I am looking at all the text that I have written in the last 11 minutes and my eyes are starting to glaze over. I just see a lot of letters and characters and start zoning out. I think that I could actually get over this and get used to it, but it will definitely take a while. I think that it also would be a lot better if I was writing all of this in Microsoft Word instead of on Dragon pad. I think this because Microsoft Word's page view is something that I am more accustomed to in overall has a better visual image. I should mention that the reason why I did not use Microsoft Word is because there were significantly more errors using that program back in Dragon pad. I think the biggest reason there were more errors in Microsoft Word was because all of the tanks were not taken out in the version that I have of Dragon with Microsoft Word. I do know that the version that I have Dragon which I think is 9.5 is about two versions older than what is out currently. I used this version because it is the latest one that the LWD lab has. All I have to say is that this version that I am using is so much better than the ones I used in the past. I could probably kiss the person who made this version because it's so much better. With the past versions I just wanted to strangle it and most of the time I made fun of it while I was using it and afterwards.

I still have one huge concern while using Dragon that I did not have with other technologies. That concern is that because I am using my voice to "type" i.e. unconsciously talk as if I was communicating with another person. I often do not change the way I word my text or reread it over like I do when I use any other typing method. I wish there was a way to analyze the overall format and content of the different entries and see if there is any relationship with the quality of the entries and the type of technology used. I definitely think that using Dragon eye have more fragmented sentences and more run-on sentences. I know that I can go back and fix all of these, but as I before when I look at all of the text my eyes glaze over and I zone out. I do know that revising a lot of what I type using any technology is something that I need to learn to get used to and become an expert doing. It really is a good skill set to have. Right now I'm trying to think of more things to write about, good my brain is just going dead. I feel like I don't have any more to say. I think one of the reasons that I do not have a lot to say is because I am writing so much each day about the same topic in such a short amount of time.

Since my last entry I have been thinking about my negative attitude towards technology. I really just have to get over it and accept that I need it. I think one way that I am going to do that is to force myself to frequently used different system technology to type and just use in general. I realize that the more that I use different technologies, the better my attitude is towards using different things. Sometimes, I wish I could get my stubborn as him and attitude thrown out the window. This sometimes does more harm than good, especially when it is opposite of what I should do. This attitude that I have towards technology seeps into other parts of my life to, especially ones pertaining to disability. Since the beginning of college I have realized that I have a bad edit to put anything that actually helps me that is related to my disability. Actually, this realization should have occurred since I was two years old. I never ever wanted anyone to help me or anything special. I just wanted to do it independently. Even as a kid I always had the thought in the back of my mind that the things that could help improve my life could always be taken away, so I had to figure out a way to do every activity without using many extraneous resources. When I was a child the first signs of this attitude was seen when I would drop the



items on the floor. I would not be able to reach them because my arms are so short. Instead of asking help from somebody next to me I would take 30 minutes to try to pick the stuff up. If that person tried to help me and did pick the item up I would throw a fit and grab the item from that person and throw it back on the floor. I then proceeded to tell them to get away from me because it was something I had to do by myself. In this case I was not using technology per se, but the person was a type of assistance in resource that could easily have been used to get what I needed to have done. In a way that person would be like how I use APA to be independent. No, I do not do my personal living routines physically by myself, but I do independently do it by telling my PA what to do. Another example from when I was younger where the bad attitude towards disability related things was when all of the professionals tried to teach me how to eat using a feeder. I hated that stupid thing. It was this huge big box that was controlled using a joystick and switch. The joystick and switches was be able to scoop up food, turn the plate, and elevate the kitchen utensil up toward your mouth. I thought it was the weirdest and dumbest invention on the face of the earth. Sure, you could eat independently and eat using kitchen utensils, but you look like a fool doing it. I do not understand why I cannot just reach down and eat with my mouth. Yes, I realized that I looked a little bit different eating with my mouth onto the plate, but eating using this robot device didn't make me look anymore the same as people who ate with their arms and hands. If anything, I looked more disabled and I also made more of MS using this stupid machine. In addition, I never quite felt like I got enough food because I could not get the amount of food that I really wanted on my utensil and do it fast enough to appease my huge appetite. As a child I also wondered how I would actually use this machine everywhere that I went. I obviously cannot set it up by myself so I would always need a PDA to do it. In my head if I had to have a PA to set it up every single time, how is that actually being independent? In my head it was the independent, it was just a silly thing that materialistic driven and vain people invented in order to make people look and do things for the way that they thought was best. I was definitely not into that and after using the system a few times I rebelled at home and told my mom that was never going to eat again if I had to use the stupid machine. Thankfully, the machine was taken away and I never had to see that thing again. A more recent negative attitude towards disability related items is my wheelchair. I have always had a love-hate relationship with that thing. I know it is really helpful for me to have, but it also feels extremely limiting in some ways. For me a wheelchair is definitely an item that only transports me from place to place. It is not something that is a part of my body. It makes me more disabled when I am in it. In my chair I cannot move in small places easily, do anything with my arms, hands, upper body including my neck and jaw, and I feel more isolated in it. Also, I just don't feel right sitting in it. I know that I can make it feel better if sitting in that by making it more customized to my body, but I have no clue what would be the right thing for me. I have gone to multiple rehab specialists that work on shared customization and all of the items they have do not really fit my needs. I don't really need a chair that has side supports or any kind of supports. I think that it would be nice if I could get a chair that my back would actually touch, but I cannot even imagine sitting with my back touching something. I also thought about getting a seat cushion that conforms more to my butt but that also seems strange. Yes, I definitely agree it would be comfortable, but would I be able to actually move in any other position besides the one that is molded. I have been looking into getting a new wheelchair and the one that I hope to get IM pretty sure will not have a seat that is exactly my size. I looked at the seat leaned and saw that it is roughly 3 inches longer than the length of the top part of my leg that would be resting on it. It will be the same length as my current wheelchair right now which is too big for me. They do have smaller seats,

but the smaller seats only common in junior chairs that do not go as fast. Of course, going fast is highly important for me so I will sacrifice my comfort for speed. Most of the time I will grumble about all of these year occasions that I get well-being in my wheelchair but I have a slight love for it to. I do have to say that in the last year or sunset has been breaking a lot I have gained an appreciation for it. Yes, it still annoys me, but I realize how it is important in my life. I can survive without it, but I truly need it if I am going to live this far away from campus. I can walk to campus and walk all day, but a lot of my energy and cognition is put into getting from place to place that I did not have to do when I am in my wheelchair. And not thing that I also love about my wheelchair is that I know how to fix it and I feel very powerful and masculine getting my tools out of my backpack and having a total stranger fix my chair. Might wheelchair really is my baby and I would honestly be devastated if anything were to happen to it and any of my previous wheelchairs. Actually, when my family got rid of my first power wheelchair ever I became so angry and sad. I just do not want to ever let that thing go even though it had not been working for over 17 years and it had so much cat shit and paste on it from being out in the barn that it was fouled to be around. However, it was still my little baby and my love. I always imagined turning it into a queue little flowerpot thing that I could play in my front yard as a garden peas. I would probably have taken out all of the motors, batteries, any type of electronics out of the base and put all of the flowers inside that. I also would have done a mural or some kind of cool painting on the seat. I can also imagine myself making a weird figurine or some other artistic vein all of the pieces of the joystick. Yes, I can see it right now. I would have a small little umbrella like Sun catcher or tiny windchimes going from the top of each but in and joystick controller. It wouldn't look so cool. I definitely think I will do this with some kind of wheelchair in the future. Man, I miss that chair. I think that if I ever see one being sold on eBay that is really cheap and broken relatively by it and do this to it. It will forever be my little baby. Okay, I'm done being silly. I think I will leave right now thoughts of my baby chair in my head.  
3:22 PM

### VRS Journal Entry 5

November 1, 2010 12:38 PM

I really do not have much to say today. I am completely drained of ideas related to technology and disability. There is one area in this thesis related to technology that I did not test. I did not look at the important factors that play a role in picking a technology when I am trying to do multiple activities at once. I thought of this idea today he and my statistics class. I realize that in that class I am often far behind the professor and the other students. In this class we use a computer and the M. plus statistical programming software. Most of the other students bring in their laptop so that all of the work that we do is always readily available for them wherever they are. Also they are able to put their own copy of M. plus on your computer which is extremely helpful because ready state does not have the program on the campus computers. You could install the program every time you use a campus computer but that is a pain in the butt. In this program you often do a lot of programming, going back and forth between the input and output views, look at different models, and also look at the PowerPoint notes on your computer. All of these tasks involve a lot of transitioning between the computer keyboard, the mouse, and any hand written notes you need to look at or make. For me this is extremely hard and the reason why I fall behind in class. I am the only student in the class that does not bring their laptop so I have to install the program demo every single time I go to class. This demo is frustrating to use

because of some of the limitations put on it because it is a demo. I do have the full version on my laptop, but it is too difficult to bring the disc everywhere I go when I use a campus computer. The campus computers are obviously made for the general public and are not fit for my needs. I used the basic mouse and keyboard with my packing of my pointer fingers to type. I don't mind doing either the mouse control or just the keyboard control, but it is difficult to do both of them simultaneously. I have to change the positions that my body and my equipment I am using was each position. On top of it, I have two tried to remain balanced on the rolling chair that always moves around because I cannot touch the ground well in it. I could lower the share to a height where my feet kind of touch the ground, but then I would not be able to reach the keyboard nearly as easy as I do now. The only frustration that I have using the desktop as a stay before it is transitioning from the keyboard to the mouse and back to the keyboard. I wish that I could stay in one position so all of the movements were fluid. I'm thinking about different technologies that would enable me to stay in one position and also be strongly easy to do both tasks. I know that one of the biggest reasons why I chose a tablet PC and stylists was to make it easier to transition from cursor movements and typing. I really like this part of using the stylus and tablet PC. It is all one fluid action that to me seems extremely quick. A lease, it is much quicker than when I used a stylus on a regular keyboard and a trackball with my chin. It also allows me to have less of a headache from moving my head back and forth between picking up the stylists, dropping the stylus, moving the ball, and reaching for the different buttons to click. I wonder how the three different tech counties that used would work with transitioning between cursor movements and typing. Brainfingers and the head tracker would all have the same techniques between the two activities. Typing in these technologies is basically just cursor control. My overall body position and techniques I use for typing and cursor control are exactly the same. I definitely think that Brainfingers would be a lot slower and more tedious the head tracker due to having to be able to control each Brainfingers so precisely. For the most part the head tracker would have the same performance and quality using cursor control and typing. However, I actually do see an annoying transition occurring when I am completing the two activities. This transition has actually seen when typing too. What happens is that as I move my head to reach a key or area on the computer continuously, my head somehow keeps on turning the side while the cursor does not have the same proportion of movement on the screen. This is because the screen is a set size while the movement of my head and body is much larger and the bigger per portion. To fix this transition by have to do is quickly jerk my head back into neutral position which is straightforward and the cursor on the screen usually stays in the exact same place because it was such a quick jerk. When using drag and I would also just be using my voice to dictate commands just the same as the way I am typing right now. However, I think that completing cursor control and transitioning from transcribing text to commands would be cognitively difficult. When using voice for cursor control there are so many different rules that you should follow and have to remember in your head. When you transition you have to quickly search in your brain for the cursor control command information. I imagine why I'm doing that my brain has a little librarian inside of it on a rolling ladder wheeling around the random knowledge encyclopedias in my brain. I think that this librarian would also have water skates on and have reflexes like a cat. Once I found the information they would jump down from the ladder and roller skate to the pardon my brain that needs the information as quick as they could. In general using Dragon for cursor control is highly frustrating for me. I often just want to use a regular mouse and not deal with the cursor control. I personally cannot stand it. It has so many tedious tasks that you have to have, numerous commands, and it diminishes all of my cognitive

resources. I wonder what would be a great technology that would allow someone to do both cursor control and typing in an efficient and easy to use manner. I wonder if this IE were given these technologies at the state of invention that they are at right now if completing each type of computer activity would actually be less annoying and frustrating. I wonder this because in all three differences of technologies I am using the same method to do, unlike when you type you use a keyboard and when you move the cursor you use a mouse. In essence it seems that the other technologies would be a better method to do both activities. I also wonder what people who are able to use a regular computer the typical way would think the three different technologies and the way you interact with them if they were initially given the different assistive technologies before the current typical way to use a computer. This reminds me of a discussion that I had in my human computer interface class my first year of grad school. One of the students had questioned whether post it notes would be as an amazing of an invention as they are currently seen now if they had been introduced after all of this technology that enables people to send quick text messages, e-mails, add notes to ideas or events (similar to Google wave), and other small household technology gadgets. Would it be easier and seen as more "normal" for us to use these alternative devices as message reminders than what post it's our now. What I find it interesting is that there are applications for the computer and for your phone that have things like posted and are even shaped just like them that you buy at the store. Now, what is the point of having a reminder designed like a Post-it? I definitely understand having a reminder and having a little icon or marker that brings attention to the fact that it is there, but why does it need to be a square yellow thing? Yes, I know the real reason is because that is what we are used to seeing in our everyday life and it's just visually pleasing. I know for myself I try to use these digital posted by they were too distracting for me to see on my computer screen all the time. Plus I did not like that in other program was running. I really like having a reminder and regular pay per patent posted form stock on the side of my desk, bed, computer. I plainly just like seeing a real-life image and not a digitizer screen. I really wonder why I don't like seeing things digitize all of the time. It really gives me a sense of security and a little bit of happiness when I see something in real life. Now I definitely sound like a crazy person, but oh well. All of this talk makes me wonder what it actually is on a digital screen that bothers people from reading on it. I know that reading devices like the Kindle and the note have helped make reading on the screen better, but how? It is so intriguing. I had a candle myself until I broke the screen and I rather enjoyed reading on it. The transition from the page turning it in somewhat of a headache because of the quick change in visual information going to my eyes. Overall I did like it and I get the least amount of headache reading on the Kindle compared to reading on a phone, iPod touch, or any kind of computer screen. Maybe it is because those screens text is more dole on the eyes. I have never really looked at the note but I know on the Kindle that there is barely any light beneath the screen and the light shades of gray as the background is appealing to the eyes. Man, I really want to look up studies about the screen technology and its appeal by its users.

Before I leave the session I want to make a quick comment about the number of errors I relatively saw when typing today. I think I saw last this time then two sessions beat before, but it still seems like a lot more errors than the first session that I completed where I did not correct any errors. It only drove me nuts a little bit today, but I still get a little attitude about it. I probably could adjust to it, but I definitely would want to fix at least some of the errors while I am typing. That way the dictation accuracy still stays up high and I don't get too annoyed with it. I wonder how many hours correcting all of the errors during text input would make the accuracy of the dictation level off at high percentage. Obviously there will always be corrections

to errors, but when it levels off I could definitely see myself typing like I am now where I do not correct any errors until later. Throughout all of these past entries I have not been paying any attention to the yellow dialog box except for when I move the cursor. A coincidence in the last sentence concerning the words "correct any errors" I saw that dragon thought that it was a command and started correcting text that had the words any errors. I wonder how many other times dragon thought that what I was saying was the command and not text. Well, that is something I will have to see later. Until then, adios. 1:36 PM

### VRS Journal Entry 6

November 3, 2010 4:25 PM

I am feeling sick today but still trying to get stuff done. I think my computer feels sick to because it is being slow again. I probably should have turned it off and let it rest for a little bit before I did the session. Oh well, it will still get everything done and needed to get done. I noticed that there seems to be a difference between stylus typing in a journal and typing using Dragon without errors when I was inputting the data points into Excel. Stylus typing seems to be a lot longer than using Dragon without correcting for errors. I wonder how long it would take me to correct all of the errors that Dragon has made in these journal entries. I would think that it would take quite a bit of time. I think that after I am done with all of these entries that I should compare the Dragon entries with making errors against these entries without making errors and see if they are significantly different. I do know that there is a lot of variability between each entry because the flow of thoughts from my head to my mouth or stylus isn't always consistent. Lately I have been not knowing what to talk about in these entries. I tried to do these entries currently without stopping at all and not letting myself do anything like check Facebook, e-mail, text messages, etc. I never realized how difficult of a task this is for me to do. I wonder if staying on one window and one task is this difficult for everybody else. I do have to say that typing without correcting for errors is nice for a least one reason. That reason is that I do not have to watch the screen nearly as much as I did when I did correct for errors. This means that I can lay any way I want to on the bed as long as my head is in roughly the same position that it has always been when I type like this. Currently because of a headache that I have I am leaning sideways perpendicular over the bed with my feet on the floor and head on the pillow. I am able to support my head nicely on the low end have my eyes closed while I type all of this stuff. I don't know why, but I always like being in a position like this when I am tired of laying on my stomach. All of my past roommates and PAs voice laugh at this position because right when they pass by my door all they see if my big butt in the air. I wonder if other people like doing this to. I will give a disclaimer is that every few sentences I do check the screen to see if roughly the right words are being dictated.

Often I am asked whether I would want to not have a disability if there was a way they could be taken away. Usually my answer to that question is no way. I like how I am and I can't imagine being another way. To me it would be so strange if I actually had to open the door for other people or even wash my hair by myself. Yes I would love to be able to do that, but I really would have no clue what to do and how to do it. I didn't even know until last year that a lot of heads go foam being bitter in the back and then having a little ledge where get smaller in the front. I thought I was just a freak of nature. I really cannot imagine what it would be like to be able bodied. It'd be weird to have the ability to do normal things by myself. It also would be weird to have regular human items usable for me. Yes, it would be great, but it would be really

weird to. I was just thinking how weird it would be to be able to use a regular computer system without any little works are constraints that would make performance suffer. I really cannot imagine even typing on a regular keyboard with all 10 of my fingers. I still try to put my fingers in the right places when I type with my hands but it is far too difficult now. My hands have gone a lot weaker and less flexible than they were when I was nine years old. I am trying to imagine what it would be like to have my fingers spread apart and having the ability to press each key. That feels so weird but cool in my head. Currently it is making my right hand and all of its fingers tingle and wanting to be stretched out really bad. On top of using the keyboard I cannot imagine being able to use a regular mouse and not have to put my whole upper body into it to move the cursor or push a button. My arm currently just feel sore and imagining doing it with my arm and not complete torso. Man, that is so weird to me. I also think about tasks and activities that currently theme debacle in too much of a pain to put energy into. I wonder what'll it be like to have it where these same tasks were so simple and easy to do. That to me seems like blasphemy. Right now I am trying to imagine picking up a little net book and putting in a bag and curing it to school. So many people do that currently here in college, but for me it is such an annoying and tedious task. Sometimes, I imagine that doing an activity like that is the equivalent to me putting my phone and wallet in my purse and curing my purse around. It is still a slight pain, but it can be done. I know this sounds crazy, but it even though light weight nests of my phone still seems like an extremely heavy item for me to hold onto. Most of the time I hate old and my phone in my hand because my muscles get tired and when I walked with the phone in my hand I put so much energy into making sure the phone is stable in my hand that I walked extremely slow. It is just a huge pain in my butt. It really is like someone taking their laptop all. It is a pain to do but it can be done and doesn't take too much energy. However people still do not want to do it, but they are willing to do it. I would really like to see white it is from an able bodies persons perspective how they imagine life with a disability is like. Often people say that they cannot imagine it and that they give respect to people that do have a disability. However, I don't know if extra respect is always needed or wanted. I know I am biased because I have always had a disability, but I have a hard time realizing that having disability does make life more difficult. I know this contradicts everything that I've said before, but it is still a weird thing to wrap my head around. Okay, let me explain this better. Yes, I do agree some aspects of a life with a disability are more difficult than others in the same situation. However, I think that often many other areas of my life are extremely easy compared to some people without disabilities, so it all evens out in the end and in my head. I often realize that I cannot do many things physically, but in so many other ways I can and I do more things than many other people. Often my friends tell me that they could never live my life not because of my disability, but because of how much I do during the day and how busy my mind always is. They say that they get tired out just listening to me and all the things that I do every day or are some of the thoughts that went through my mind. When they say things like this, I just looked at him blankly and never understand what they are saying. To me everybody is always busy and running around like a crazy person. I just accept that as a fact of life. I guess it is also the same way that I accept that to get anything accomplished independently or you have to make sacrifices and jumps through 1 million hoops before you get anywhere. Yes, I think that everybody has to do this, but it for people to disabilities it may happen more often.

While I am thinking about what it would be like to not have a disability I would like to list the things that I "miss" the most. The first thing is that I wish I could take myself to the bathroom independently and anytime I felt like it. It is frustrating having to schedule somebody just to go

P. I also wish that I could walk up stairs a little bit better. That would make my life a lot easier, but it isn't a big deal to me. I think that the biggest thing that I wish/Ms. because I am disabled is the use of my hands to talk. I already talked quite a bit with my hands, but no one ever notices that or if they do notice it they have no clue what I am trying to explain with my hands. I do know that I currently compensate for not being able to talk with my hands I talking with any and every body part or expression that can be made using different objects or my body. I have always known that I talked a lot with my body, my it wasn't until a friend and I were holding hands and talking that I realized how much I really do it. In the middle of my talking he jokingly said that he needed a break because his hands were tired of moving. I didn't realize that while holding his hands I was still flailing my hands through my own special hand talking. I definitely think if I was able bodied I would be an extremely good actress with all of my different expressions I could make with my body, hands, legs, face. What is really funny right now is that if my hands are unable to move because I am laying on them or using them for another task I will start talking with my legs, but, or head as a replacement for my arms. It's really funny because in my head when I am thinking while I'm doing it is that the body part that is moving is actually my hands. What is really crazy is that in my head I also have a connected where different areas on my butt are correlated with different areas in my hand. For example, in my head I have the whole butt as one unit representing a thong or fixed making a big motion, one side of my butt/head as a pointing finger, etc. I know I sound really crazy right now by a kind of seems cool too. I wonder if this correlation has anything to do with the census I get from each toe or flat going to my butt and spine. Obviously, I separate each foot as if it's a hand and each toe as if it is a finger, so when I moved that specific so or foot then it sends sensory signals up to different areas of my butt. Wow, I never realized that this is why I often did when I communicated with my hands or even road on my wheelchair and wiggled my feet as if it was going through whatever ground I was driving over. I wonder if other people disabilities do the same thing. I think I'm going to ask my friends this question because I don't think I am the only weirdo out there that's done this.

I'm thinking about the different things that I really like about having a disability. One of the biggest things that I love about having disability is that I do get to live a different kind of life. I like that I always have to be searching for ways to accommodate myself. I also like that it gives me something to do with my brain 24 seven. Yes, it is annoying and frustrating and that always seems to be some kind of stupid necessary drama going on whether it has to do with PAs, wheelchairs, assistive technology, but in a weird way I like it. It makes me feel like I am always busy and somewhat always doing something productively. The biggest thing that I love about being disabled is truly the relationships and connections that I get with anybody that I may come in contact with. Yes, obviously I come in contact with specialists pertaining to anything disability related, other people disabilities, and other families that deal with disabilities, but what I really love are the winner at random strangers and conversations that I somehow get into due to having a disability. For example, I have made so many different friends while being on the elevator. To be honest I probably can only remember one person's name, but simply asking them every time we on the elevator together to push the button and other random chitchat is a cool bond. You never know when to run to, what they are going to say to you, and how close the relationship could actually become. Yes, everyone can run into people on the elevator and have random chit chat, but I really feel that my disability has made me have more conversations than the normal person. This is not the quirky thing having disability, but I love it. I also love that just like humans and our behavior living with a disability provides a life where you expect the

unexpected. You never know what you're going to get, how you're going to get it, and what the hell the next thing to do is. The best way I can relate the unexpected events you get with a disability is mixing force comes cold life is like a box of chocolates, but it also adding Harry Potter's Bertie Botts every flavor jelly bean. Yes, you never know what you're going to get, and on top of it you may get some really nasty crap that no one else will get, and you may have to do some real special magic to get out of the funk whether it is an experience, situation, event, or just a nasty tasting flavor in your mouth. I think that I love living and anything pertaining to it because of all these unexpected things that may occur and always having to figure out new, random, ridiculously difficult ways to get out of whatever you got yourself into. Between that and making a variety of different kinds of relationships, what else is there to live in life? It is a big reason why I love the life that I live and never want to change it. Well, that is all for now. I really like talking about this. 5:16 PM